FINAL REPORT

Group III Impoundments Corrective Measures Study/ Feasibility Study (CMS/FS) Final Report Bound Brook, New Jersey Volume 1 of 4

American Home Products Corporation
Madison, New Jersey

November 1997

O'BRIEN & GERE
ENGINEERS, INC.

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O'BRIEN & GERE
ENGINEERS, INC.

November 6, 1997

Mr. Haiyesh Shah, Case Manager
Bureau of Federal Case Management
NEW JERSEY DEPARTMENT OF
ENVIRONMENTAL PROTECTION
401 East State Street, 5th Floor
Trenton, New Jersey 08625

Re: Group III Impoundments
Corrective Measures Study/
Feasibility Study Final Report
Bound Brook, New Jersey Facility
American Cyanamid Company

File: 5772.013 - Task 6#2

Dear Mr. Shah:

On behalf of American Home Products Corporation, please find enclosed one copy of the above-referenced report. This report incorporates New Jersey Department of Environmental Protection and United States Environmental Protection Agency comments to the April 1996 version of this document, as received through the November 3, 1997 comment letter. Additionally, by carbon copy of this letter two copies of this report have been transmitted to USEPA

Please contact Tom Donohue of American Home Products Corporation at (201) 683-2294 if you have any questions.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Angelo J. Caracciolo, III
Project Associate

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cc: Jim Hacklar, EPA Region II (2 copies)
Thomas M. Donohue, American Home Products Corporation

AMERICAN CYANAMID COMPANY, BOUND BROOK, NJ SITE

GROUP III IMPOUNDMENTS

CORRECTIVE MEASURES STUDY/FEASIBILITY STUDY FINAL REPORT

CERTIFICATION

N.J.A.C. 7:26C-1.2(B)

I certify under penalty of the law that the information provided in this document is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.

American Home Products Corporation

H.J. Hintz 11/5/97

H.J. Hintz
Assistant Vice President
Environmental Affairs

11/5/97
Date

Notary:

Sherri A. Cauwels

Notary Public
SHERRI A. CAUWELS
A NOTARY PUBLIC OF NEW JERSEY
My Commission Expires March 7, 2000

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AMERICAN CYANAMID COMPANY, BOUND BROOK, NJ SITE

GROUP III IMPOUNDMENTS

CORRECTIVE MEASURES STUDY/FEASBILITY STUDY FINAL REPORT

CERTIFICATION

N.J.A.C. 7:26C-1.2(C)

I certify under penalty of the law that I have personally examined and am familiar with the information submitted herein and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.

American Cyanamid Company

S.A. Tasher
Vice President

11/5/97
Date

Notary:

Sherri A. Cauwels
Notary Public

SHERRI A. CAUWELS
A NOTARY PUBLIC OF NEW JERSEY
My Commission Expires March 7, 2000

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O'BRIEN & GERE
ENGINEERS, INC.

November 6, 1997

Mr. Thomas M. Donohue
Manager of Environmental Affairs
Department of Environment and Safety
AMERICAN HOME PRODUCTS CORPORATION
One Campus Drive
Parsippany, NJ 07054

Re: Group III CMS/FS - Final Report

File: 5772.013 - Task 6#2

Dear Tom:

Please find attached the Corrective Measures Study/Feasibility Study Final Report (CMS/FS) for the Group III Impoundments at the American Cyanamid Site in Bound Brook, New Jersey. This final report has been developed in accordance with the requirements of the 1988 Administrative Consent Order, as amended in 1994, and the requirements of CERCLA and RCRA. This final report incorporates New Jersey Department of Environmental Protection (NJDEP) and United States Environmental Protection Agency (USEPA) comments to the April 1996 version of this document. Please note that this final report includes the following items as requested by NJDEP in their final comment letter dated November 3, 1997: a revised paragraph 2 on Page 5-2; the Impound 8 plans and sections as Figure 9-1; and, an updated schedule as Figure 9-2.

Should you have any questions, please call me.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Angelo J. Caracciolo, III
Project Associate

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cc: Mr. Gary A. Angyal, O'Brien & Gere Engineers, Inc.
Mr. Steven J. Roland, O'Brien & Gere Engineers, Inc.

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. . . and offices in major U.S. cities

5772.013.421

Final Report

Group III Impoundments Corrective Measures Study/ Feasibility Study (CMS/FS) Final Report Bound Brook, New Jersey Volume 1 of 4

American Home Products Corporation
Madison, New Jersey

Steven J. Roland, P.E.
Senior Vice President

November 1997

O'BRIEN & GERE ENGINEERS, INC.

Raritan Plaza I
Edison, New Jersey 08837

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Acronym list

ACO	Administrative Consent Order
AHPC	American Home Products Corporation
ARARs	Applicable or Relevant and Appropriate Requirements
ATP	Anaerobic Thermal Process
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental, Response and Compensation Liability Act
CMS/FS	Corrective Measures Study/Feasibility Report
DOT	Department of Transportation
EP	Extraction Procedure
GAC	Granular Activated Carbon
HC	Hard and Crumbly
IGW	Impact to Ground Water
IPC	In-place Containment
LDRs	Land Disposal Restrictions
LOS	Light oily sludge
LTTT	Low Temperature Thermal Treatment
LTTA	Low Temperature Thermal Adsorption
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRSCC	Non-residential Soil Cleanup Criteria
NJDEP	New Jersey Department of Environmental Protection
O&M	Operation and Maintenance
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSCC	Residential Soil Cleanup Criteria
SARA	Superfund Amendments and Reauthorization Act
SESC	Soil Erosion and Sediment Control
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TBCs	To be considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEMD	Thermally Enhanced Mechanical Desorption
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTSs	Universal Treatment Standards
VOC	Volatile Organic Compounds
VR	Viscous and Rubbery

Executive summary

This final Corrective Measure Study/Feasibility Study (CMS/FS) report for the Group III Impoundments (1, 2, 3, 4, 5, 14, 20, and 26) at the American Cyanamid Company (Cyanamid) Bound Brook facility was prepared on behalf of American Home Products Corporation (AHPC) in accordance with the substantive requirements of the 1988 Administrative Consent Order (ACO) as amended; the Resource Conservation and Recovery Act (RCRA); and the Comprehensive Environmental Response, Compensation and Liability Act as amended by the Superfund Amendment and Reauthorization Act (CERCLA/SARA). American Cyanamid Company is a wholly owned subsidiary of AHPC. This document has been revised from the April 1996 document based on comments provided by the USEPA and the NJDEP and the mutually agreed upon responses.

The eight impoundments within Group III hold a total of nearly 210,600 yd^3 of material which contain volatile and semivolatile organic compounds. Two previous CMS/FS Reports submitted to the agencies (for Group I and II) address the remaining eight CERCLA impoundments at the facility.

The objectives of this report are to:

- develop remedial action objectives for the Group III impoundments
- identify and screen applicable remedial technologies and process options for the Group III impoundments
- determine appropriate treatment objectives and calculate associated risk reduction
- develop, evaluate, and compare remedial alternatives in accordance with CERCLA guidelines
- identify a recommended remedial alternative.

Impoundments 1 and 2 were originally in Group II and as such the recommendations for those impoundments were presented in the May 1994 Group II CMS/FS Report (BB&L 1994a). The CMS/FS activities for the original Group III impoundments were summarized in the May 1995 Group III CMS/FS Report (BB&L 1995). These reports presented low temperature thermal treatment (LTTT) and bioremediation as the most appropriate remedial actions for the respective impoundments. This was based on laboratory studies demonstrating that the technologies were effective in treating the impoundment materials to meet toxicity characteristic leaching procedure (TCLP) levels. Final placement of treated residual would be into Impound 8 which would be designated as a Corrective Action Management Unit (CAMU). Impound 8 is an on-site permitted, triple-lined, hazardous waste management facility. The New Jersey Department of Environmental Protection (NJDEP) and United States Environmental Protection Agency (USEPA) determined that TCLP levels were inappropriate to use as treatment objectives prior to placement into Impound 8. For this reason, Impoundments 1 and 2 were transferred to Group III, and the May 1995 Group III CMS/FS Report was voided pending the results of further field scale treatability studies to identify appropriate, achievable treatment objectives for Impoundment 1 and 2 and the original Group III impoundments.

The results of the pilot scale treatability studies showed that the technologies could not consistently meet land disposal restrictions or Superfund variance levels. Incineration of the materials would be required to meet those levels. To utilize the proposed technologies, Impound 8 would need to be designated as a CAMU. Therefore, in developing this CMS/FS it was assumed that the Impound 8 facility would be designated as a CAMU with the use of treatment to enhance the protection of human health and the environment afforded by this triple-lined waste management facility.

The treatability study data were used to identify achievable treatment levels for the Group III impoundment materials. These levels were then adjusted to account for transition to full-scale systems. Appropriate treatment objectives for the materials prior to placement into the Impound 8 facility were then developed. The treatment objectives were evaluated based on risk which demonstrated that treatment to the developed objectives yielded greater than 95% reduction in relative risk based on toxicity, mobility, and volume.

This document presents the redeveloped CMS/FS Report for the new Group III Impoundments (1, 2, 3, 4, 5, 14, 20, and 26), as revised based on USEPA and NJDEP comments to the initial 1996 CMS/FS report for the new Group III Impoundments. The main focus of the report is to present the results of the treatability studies and the development of associated treatment objectives within the evaluation of remedial alternatives. This approach streamlines the evaluation by focusing on treatment levels and remedial solutions which have been shown to be protective of human health and the environment when applied to these materials. Although placement of the material, even untreated, virtually eliminates risk to human health and the environment, a relative risk assessment was performed to evaluate the risk reduction gained by treating the materials to the treatment objectives.

In order to focus the development and comparison of remedial alternatives, the impoundment materials have been characterized based on physical and chemical characteristics and material handling properties. By categorizing common materials within the Group III impoundments, a more consistent treatment evaluation can be conducted for each material category. The categorization is also more adaptable to full-scale remediation.

The material categories used in the CMS/FS were developed based on material types, physical handling properties, and existing analytical characterization and are summarized below:

- Category A - High Btu tar (Impoundments 1 and 2)
- Category B - Low Btu tar/sludge (Impoundments 4, 5 (wet), 14, 20)
- Category C - Impoundment 3
- Category D - Non-hazardous material (Impoundments 5 (dry) and 26)
- Category E - General plant debris (Impoundments 3, 4, 5, 14, and 20).

The material categories and results of the treatability studies were combined in developing remedial alternatives for each category. These alternatives were then evaluated against seven of the nine National Contingency Plan (NCP) criteria: protection of human health and the environment; compliance with appropriate or relevant and appropriate requirements (ARARs); long-term effectiveness; reduction of toxicity, mobility and volume; short-term effectiveness; implementability; and cost. The remaining two criteria, public acceptance and USEPA acceptance, will be considered once the Proposed Plan is issued and therefore, at the request of the agencies, were not evaluated at this stage.

In the comparative analysis, the alternatives were compared to one another based on the seven NCP screening criteria. This process identified relative strengths and weaknesses among the alternatives. Based on the CMS/FS process and evaluations as presented within this report, the following remedial alternatives are recommended:

Category	Description	Recommended Alternative	Estimated Cost ($million)
A	High Btu tar	LTTT	$27
B	Low Btu tar/sludge	Bioremediation	$33
C	Impoundment 3 material	LTTT	$10
D	Non-hazardous material	Consolidation in Impound 8	$1.8
E	General plant debris	Consolidation in Impound 8	$0.8
TOTAL			$72.6

These alternatives meet the remedial action objectives for the Group III materials and can meet the treatment objectives, where applicable, based on field testing. The recommended alternatives satisfy the evaluation criteria and virtually eliminate risks to human health and the environment through ultimate disposal in the triple-lined Impound 8 waste management facility. Critical to the evaluation and selection of the alternative is the fact that the Impound 8 facility, designated as a CAMU, in and of itself satisfies the remedial action objectives and the evaluation criteria. Treatment to the developed treatment objectives, as proposed, enhances the permanence of the remedy by further reducing the risks posed by the materials relative to the compounds detected.

1. Introduction

1.1. Overview and objectives

This CMS/FS Report has been prepared on behalf of AHPC for the Group III impoundments at the American Cyanamid Company (Cyanamid) facility located in Bridgewater Township, Somerset County, New Jersey (Bound Brook facility). Cyanamid has been a wholly owned subsidiary of AHPC since November 1994.

Cyanamid entered into ACOs with the NJDEP related to investigation and remediation at the Bound Brook facility in 1982 and 1988; the 1988 ACO was amended in 1994. The USEPA is a support agency to the NJDEP on this project. The 1988 ACO required corrective action for sixteen impoundments at the Bound Brook facility. In order to facilitate remedial alternative evaluation and remediation management; Cyanamid, NJDEP, and USEPA agreed to organize these sixteen impoundments into three groups according to impoundment material types, impoundment constituents, impoundment location, and potential remedial alternatives. These sixteen impoundments were grouped as follows:

- Group I - Impoundments 11, 13, 19, and 24
- Group II - Impoundments 1, 2, 15, 16, 17, and 18
- Group III - Impoundments 3, 4, 5, 14, 20, and 26.

The Group I CMS/FS was submitted to NJDEP and USEPA in 1992 and a Record of Decision was issued on September 28, 1993. The Group II CMS/FS (Impoundments 15, 16, 17, and 18) was submitted to NJDEP and USEPA in May 1994 and a Record of Decision was issued in July 1996.

The conclusions and recommendations for Impoundments 1 and 2 were presented in the May 1994 Group II CMS/FS Report (BB&L 1994a). The CMS/FS activities for the Group III impoundments were summarized in the May 1995 Group III CMS/FS Report (BB&L 1995). These reports presented LTTT and bioremediation as the most appropriate remedial technologies for the respective impoundments. This was based on laboratory studies showing that the technologies were effective in treating the impoundment materials to meet TCLP levels. Final placement of treated residuals would be into Impound 8 which would be designated as a CAMU. Impound 8 is an on-site permitted hazardous waste management facility. In a letter dated September 11, 1995 (Shah 1995) (Exhibit A), the NJDEP and USEPA determined that TCLP levels were inappropriate to use as treatment objectives. For this reason, Impoundments 1 and 2 were transferred to Group III, and the May 1995 Group III CMS/FS Report was voided pending the results of further field scale treatability studies to identify appropriate, achievable treatment objectives for Impoundments 1 and 2 and the original Group III impoundments.

The NJDEP requested that Cyanamid use the treatability studies to determine if land disposal restriction (LDRs) or Superfund Guidance #6A (2nd Edition) "Obtaining a Soil and Debris Treatability Variance for Remedial Actions" variance levels could be achieved. The treatability testing demonstrated that the technologies were not consistently successful in achieving LDRs or the variance levels.

However, it has been recognized by the NJDEP and USEPA that designation of Impound 8 as a CAMU for placement of impoundment materials may be appropriate for the site. Therefore, treatment objectives for the Group III impoundments have been developed based on the assumption that Impound 8 will be designated as a CAMU. If a CAMU is not obtained, incineration is the only treatment technology which can meet LDRs or Superfund Guidance #6A variance levels. Impound 8 is a state-of-the-art, permitted waste management facility. The use of Impound 8 as a CAMU provides for long-term effectiveness of remedial actions by eliminating the migration of constituents to air, soil, ground water and surface water.

The HSWA Part B Permit for the Impound 8 Facility was issued jointly by the NJDEP and USEPA Region II in 1988. A Class III HSWA permit modification was issued in March 1994 and is in effect until March 4, 1999. The Class III HSWA permit modification, combined with the operating permit issued by NJDEP, comprise the facility Resource Conservation and Recovery Act (RCRA) permit. The permit designates the Impound 8 Facility as a hazardous waste management facility, and specifies design and operating requirements for the facility.

According to the National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (NCP), "The purpose of the remedy selection process is to implement remedies that eliminate, reduce, or control risks to human health and the environment" (NCP §300.430(a)(1)). Disposal of materials from the Group III Impoundments into Impound 8 will accomplish this goal by essentially eliminating the potential for human or ecological exposure to hazardous substances that are present in the Group III impoundment material. The design for Impound 8 exceeds the minimum standards for a RCRA hazardous waste landfill, including an impermeable cap, multiple liners, a leachate detection and collection system, a ground water intercepter trench, and a ground water monitoring system. Impound 8 protects human health and the environment by eliminating both direct contact risks and the potential for hazardous substances to migrate to potential receptors via the ground water pathway.

In addition, consistent with the preference for treatment expressed in the NCP, AHPC has agreed to treat Group III impoundment wastes, where practicable and appropriate, to address the potential principal threats. According to the NCP, " In appropriate site situations, treatment of the principal threats posed by a site, with priority placed on treating waste that is liquid, highly toxic or highly mobile, will be combined with engineering controls (such as containment) and institutional controls, as appropriate, for treatment residuals and untreated wastes" (NCP §300-430 (a)(1)(iii)(C)). As specified in the NCP, treatment of the Group III impoundment wastes focuses on the results of the treatability testing and on the reduction of risks through reducing the toxicity, mobility, and volume of hazardous substances in establishing achievable treatment objectives.

This document presents the redeveloped CMS/FS Report for the new Group III impoundments (1, 2, 3, 4, 5, 14, 20, and 26). The main focus of the report is to present achievable treatment objectives within the evaluation of remedial alternatives. This approach streamlines the evaluation by focusing on treatment levels and remedial solutions which have been shown to be protective of human health and the environment when applied to these materials.

The 1988 ACO, as amended, addresses remediation under RCRA as well as CERCLA, as amended by SARA. Under RCRA, the alternative development and evaluation process is referred to as a CMS. The CERCLA program equivalent is a FS. This report is referred to as a CMS/FS in order to accommodate both regulatory programs. CERCLA FS terminology was utilized for report organization; CERCLA FS evaluation criteria encompass each of the issues covered by the RCRA evaluation criteria. As required by the 1988 ACO, as amended, the development and evaluation of alternatives was conducted in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 CFR Part 300) and USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988b).

1.2. Site regulatory status and history

The scope of this report includes an assessment of remedial alternatives for the final eight of sixteen on-site impoundments that are required to be addressed under CERCLA and the requirements of the 1988 ACO, as amended. This report satisfies Paragraphs II.D.23 and II.D.25 of the ACO for Impoundments 1, 2, 3, 4, 5, 14, 20, and 26. As defined in Paragraph VI.13.C of the Findings Section of the ACO - *Facility Remediation Goals*, Cyanamid was required to investigate, evaluate, and implement corrective actions for the solid waste management units (SWMUs) on-site.

Two previously approved CMS/FS Reports, dated October 1992 [Record of Decision (ROD) signed September 1993] and November 1993 (amended May 1994)[ROD signed July 1996], address Group I and Group II, respectively (BB&L 1992b and BB&L 1994a). It should be noted that Group I originally included Impoundment 20. However, this impoundment was incorporated into Group III by the agencies during the Group I remedy selection process. As discussed in Section 1.1, Impoundments 1 and 2 were originally part of Group II, but were moved to Group III in order to incorporate supplemental treatability testing results. The Group I, Group II, and Group III CMS/FS reports present the recommended remedial alternatives for the sixteen CERCLA impoundments identified in the ACO. Remaining operable units to be addressed include site-wide soils and, if necessary, ground water at the site.

The history of the Bound Brook site has been reported in numerous documents prepared for the regulatory agencies. Section 2 of this report provides a limited site history. The reader is referred to either the Group I or Group II CMS/FS reports (BB&L 1992b and BB&L 1994a) or the CMS/FS Work Plan (BB&L 1991a) for a more detailed history of the site. The following background discussion addresses only the impoundment program to place this study into context with the overall site remedial program.

In November 1988, an Impoundment Characterization Program Sampling and Analysis Work Plan for thirteen of the on-site impoundments (Impoundments 1, 2, 3, 4, 5, 13, 14, 15, 16, 17, 18, 19, and 24) was submitted to the NJDEP and USEPA (BB&L 1989a). The work plan was amended, and approved in April 1989. In February 1989, a Work Plan for investigation of the three remaining impoundments required to be addressed by the 1988 ACO, as amended, (Impoundments 11, 20, and 26) was submitted to the NJDEP and the USEPA; this Work Plan was subsequently approved and made part of the overall sampling and analysis work plan in August 1989. In May 1989, the characterization program for the sixteen impoundments was implemented.

The results from sampling and analyses of the impoundment contents during implementation of the impoundment characterization program were compiled into an extensive database regarding the physical and chemical characteristics of the impoundments. This information was presented in the August 1990 Impoundment Characterization Program Final Report pursuant to the requirements of Paragraphs II.B.18 and II.D.22 of the 1988 ACO, as amended

(BB&L 1990). Using this information, potentially applicable remedial technologies for each of the impoundments were identified and presented in the approved May 1991 Impoundment CMS/FS Work Plan (BB&L 1991a). The Work Plan satisfied the requirements of Paragraphs II.D.23 and II.D.25 of the 1988 ACO, as amended, and assisted in screening the "universe" of technologies to arrive at a more manageable number of technologies considered to be most applicable to the Group III impoundments. The technologies that were retained were fuel blending/recycling, LTTT, bioremediation, solidification, in-place containment (IPC), and incineration. The following information was used in the CMS/FS screening process:

- Data generated during the impoundment characterization program
- Results of a preliminary screening of remedial technologies described in Section 4.3 of the CMS/FS Work Plan (BB&L 1991a)
- Information generated during laboratory treatability and pilot-scale studies performed for Cyanamid on impoundment waste materials
- Information generated during vendor studies on impoundment materials.

NJDEP provided comments on the May 1995 Group III CMS/FS Report (BB&L 1995) in a letter dated September 11, 1995 (Exhibit A). In this letter, the NJDEP documented its decision to move Impoundments 1 and 2 from Group II into Group III because of the need to develop specific objectives for the recommended treatment technologies for these impoundments. The NJDEP declared the May 1995 Group III CMS Report void and required redevelopment and submittal of a CMS/FS Report for the new Group III impoundments to provide these recommended treatment objectives based on the results of the 1995 and 1996 treatability studies and other information.

Predesign testing of LTTT for Impoundments 1 and 2 was conducted in 1995 and 1996 in accordance with the Impoundments 1 and 2 Predesign Testing Work Plan (O'Brien & Gere 1995a). Field pilot testing of biotreatment for Impoundments 3, 4, 5, 14, 20, and 26 was conducted in 1995 and 1996 in accordance with the Solid Phase Evaluation Field Pilot Test for Biotreatment of Group III Impoundments Work Plan (O'Brien & Gere 1995b). The results of these supplemental treatability tests are documented in reports presented in Appendices A and B.

An initial version of the redeveloped Group III CMS/FS Report was submitted to NJDEP on April 30, 1996. NJDEP provided comments on this report in letters dated July 15, 1996 (Shah 1996a), November 25, 1996 (Shah 1996b), April 17, 1997 (Shah 1997a), June 3, 1997 (Shah 1997b), September 30, 1997 (Shah 1997c), and November 3, 1997 (Shah 1997d). AHPC provided responses in letters dated September 13, 1996 (Caracciolo, 1996), January 30, 1997 (McDonald, 1997a), and May 2, 1997 (McDonald, 1997b), July 21, 1997 (McDonald 1997c), and October 24, 1997 (Caracciolo, 1997). These letters are included in Exhibit B. This report incorporates revisions based on this set of correspondence.

1.3. Project scope and report organization

The overall organization of this report is consistent with the CERCLA FS process. Report sections are organized as follows:

- Section 1 presents an overview of the project scope and objectives, as well as the regulatory status.

- Section 2 includes summaries of the site history, impoundment characterization data, geology and hydrogeology, surface water hydrology, the Baseline Endangerment Assessment, and the Natural Resources Assessment .

- Section 3 presents the identification and screening of technologies for the Group III impoundments. It also includes the remedial action objectives (RAOs), general response actions, volumes and types of media, and descriptions of potentially applicable technologies.

- Section 4 presents the evaluation of potentially applicable technology process options with respect to effectiveness, implementability.

- Section 5 discusses the development of protective and achievable treatment objectives based on risk-analysis and pilot-scale treatability study results.

- Section 6 incorporates the recommended treatment objectives in the development of alternatives for the Group III impoundment materials and includes a detailed description of each remedial alternative.

- Section 7 identifies potentially applicable or relevant and appropriate requirements (ARARs).

- Section 8 documents the detailed analysis of alternatives for the Group III impoundment materials with respect to the following evaluation criteria:

  - overall protection of human health and the environment
  - compliance with ARARs
  - long-term effectiveness and permanence

- reduction of toxicity, mobility, or volume through treatment
- short-term effectiveness
- implementability
- cost
- regulatory agency acceptance
- community acceptance

- Section 9 presents the recommended remedial alternatives and implementation schedule for the Group III impoundment materials.

2. Site background

This section presents a brief history of the site, the geology and hydrogeology of the site, a description of the chemical and physical composition of each of the Group III impoundments, and an overview of the findings of the Baseline Endangerment Assessment and Natural Resource Assessment. Rather than providing a detailed reiteration of site history and geology, which has been presented in previous Bound Brook facility reports, only the relevant and significant components of those discussions related to the Group III impoundments are incorporated herein.

2.1. History

The Bound Brook facility is located in north-central New Jersey in the southeastern section of Bridgewater Township, Somerset County (see Figure 2-1). The facility encompasses approximately 575 acres and is bounded by Route 28 to the north, the Raritan River to the south, Interstate 287 and the Somerset Tire Service property to the east, and Foothill Road and the Raritan River to the west (see Figure 2-2).

The Bound Brook facility has been used for numerous chemical and pharmaceutical manufacturing operations for over 75 years. Currently, only bulk pharmaceuticals are manufactured at the plant. As a result of historical activities at the facility, there are a number of disposal areas, as well as impacted areas of soil and ground water. Materials generated from the past manufacturing operations were stored in 21 of 27 on-site impoundments (Figure 2-2). Of these 27 impoundments, 16 are subject to the CMS/FS program. Of the 11 impoundments not subject to the CMS/FS Program: three were never used (Impoundments 9, 10, and 12); two contain river silt from the plant's former water treatment facility and are now closed (Impoundments 22 and 23); one is utilized for the storage of emergency fire water (Impoundment 21); and five are closed or are being closed in accordance with NJDEP and USEPA-approved RCRA closure plans (Impoundments 6, 7, 8, 9A, and 25).

In addition to the storage of process materials in the impoundments, general plant wastes, solid waste and cinders from the on-site coal-fired boilers, and ash from a former on-site trash incinerator were disposed of in a number of areas across the facility. These storage and disposal practices, when coupled with the spills, leaks, and other releases of chemicals and materials that occurred in the operations of a chemical manufacturing facility with such a long and diverse history, indicate the potential magnitude for on-site soil and ground water impacts.

Detailed summaries of the site history, investigatory activities, and analytical data generated during the investigations are provided in the following reports previously submitted to the agencies:

- Lagoon Characterization Report (O'Brien & Gere 1983)
- Soils Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan) (BB&L 1989b)
- Impoundment Characterization Program Final Report (BB&L 1990)
- Impoundment CMS/FS Work Plan (BB&L 1991a)
- Hill Property Remedial Investigation Report (Hill Property RI) (BB&L 1991b)
- Baseline Endangerment Assessment (BB&L 1992a)
- Group I CMS/FS Report (BB&L 1992b)
- Group III Materials Handling Pilot Study Report (BB&L 1992c)
- Group II CMS/FS Report (BB&L 1994a)
- Group III impoundments CMS/FS Report (BB&L 1995) (VOIDED)
- Impoundments 1 and 2 Pre-Design Testing Work Plan (O'Brien & Gere 1995a)
- Solid Phase Evaluation Field Pilot Test for Biotreatment of Group III impoundments Work Plan (O'Brien & Gere 1995b)
- Natural Resource Assessment Data Summary (O'Brien & Gere 1996a).

These reports may be referenced for a comprehensive presentation of historical information, investigatory findings, and analytical data for each of the impoundments and potentially affected media at the Bound Brook facility. In this report, the presentation of historical information and characterization data are focused on that which is necessary to support the evaluation of remedial options for the Group III impoundments.

One additional component of the Bound Brook program, the Impoundments 4 and 5 Fuel Blending/Recycling Program, has positively advanced the remediation of the Group III impoundments. This program has resulted in the removal and reuse of almost 3.8 MG (18,700 yd^3) of pumpable tars from these impoundments, which comprises approximately 10 % of the total waste volume in Group III.

2.2. Geology and hydrogeology

2.2.1. Geology

The site is situated in the New Jersey Piedmont geomorphologic province, which is an area of rolling, low-lying terrain interrupted only by the Watchung Mountains, approximately 1.5 mi north of the site. Overall, the site is relatively flat, with a natural slope and direction of approximately 2% to the south-southeast towards the Raritan River.

Detailed descriptions of the site hydrogeology and geology are provided in Section 2.4 and Appendix A of the Soils RI/FS Work Plan previously submitted to the agencies (amended May 1992). Exhibit C illustrates the generalized site stratigraphy discussed below.

Surface geology. The natural soils of the site belong to the Dunellen-Rowland-Birdsboro Association. These are well-drained to somewhat poorly drained loamy soils formed in glacial outwash, or alluvial deposits which occupy floodplains and terraces. Birdsboro soils do not occur at the site. Other (minor) soils encountered at the site include the Lansdowne silt loam, the Raritan silt loam, and the Parsippany silt loam. Man-made fill/general solid wastes and disturbed soil and gravel also exist at ground surface in portions of the site.

Geology of unconsolidated deposits. The general area of and around the Bound Brook facility is covered by naturally occurring unconsolidated sediments ranging in thickness from 5 to 30 ft. These sediments are either the weathering product (residual soils) of the underlying bedrock, or they are fluvial deposits related to the adjacent Raritan River. The unconsolidated deposits consist of a mixture of silt, clay, and shale fragments. In the southern portion of the site, the fluvial deposits overlie the weathered bedrock zone and thin out to the north, until only residual soils are encountered. The unconsolidated deposits are composed of the following sequence from ground surface to the top of bedrock.

- *Clay sequence.* The silt and clay sequence acts as a hydraulic barrier, due to its low permeability as compared to the sand and gravel below and the man-made fill above. In places, the silt and clay sequence has been removed during the course of site operations. Over these deposits, a layer of non-native sand and gravel or other man-made fill can often be identified.

- *Sand and gravel sequence.* Underlying the silt and clay sequence is a sequence of sand and gravel mixtures which generally tend to fine upwards.

- *Weathered shale.* A thin veneer (2 to 3 ft thick) of silt, clay, and shale fragments generally overlies the bedrock. This residual soil is the product of the weathering of bedrock.

When viewing the overburden deposits from a site-wide perspective, it can be seen that the entire sequence of overburden deposits (silt and clay, sand and gravel, and residual soil) tend to be present across the site.

Bedrock geology. The site is underlain by the Passaic Formation of theTriassic-age Newark Group. The Passaic Formation is a series of characteristically red siltstones, sandstones, and conglomerates.

The underlying bedrock surface has been modified by erosion. The western part of the site subsurface is occupied by a bedrock high, the sides of which are incised by deep, rapidly descending, V-shaped valleys. These valleys are oriented in a general north-south trend. These bedrock surface features control the composition and distribution of the overlying water-bearing units, and the ground water flow regime in the overburden aquifer system.

2.2.2. Hydrogeology

Ground water hydrology. Two aquifer systems underlie the site: a shallow overburden aquifer system, and a deeper semi-confined bedrock aquifer system. The two aquifer systems are separated by a zone of weathered bedrock.

Overburden aquifer system. The overburden aquifer system consists of two water-producing/water-transmitting units: an unconfined surficial man-made fill unit, and an underlying confined to semi-confined sand and gravel unit. The two units generally are separated by a low permeability silt and clay unit as described in Section 2.3.1. Where the silt and clay were physically removed by site operations, the fill material is in contact with the underlying sand and gravel unit, and the two units are hydraulically connected.

The surficial fill and disturbed soil unit (man-made deposits) contains a regionally discontinuous water table aquifer which occupies the uppermost 2 to 4 ft of soils, predominantly in the main plant area of the site. Ground water in the fill occurs 6 to 18 inches below ground surface. The predominant flow component within this layer is downward. The secondary horizontal ground water flow component within this unit is generally north to south towards the Raritan River.

The sand and gravel unit generally behaves as a confined to semi-confined aquifer. This unit has a 10 to 20 ft saturated thickness, and is the significant member of the overburden aquifer system. Where the silt and clay unit is not present, the sand and gravel unit behaves more like an unconfined aquifer. The horizontal ground water flow direction exhibits a divergent pattern. Generally, a ground water divide is defined by a line from the Impoundment 5 complex to the northeastern corner of the main plant area. The site-wide generalized overburden ground water flow is illustrated in Exhibit D.

The vertical head relation between the surficial fill and the sand and gravel unit suggests that the potential for vertical flow is downward from the fill into the sand and gravel. The overburden ground water is not used for public or private water supplies.

Bedrock aquifer. The water-bearing unit for the bedrock aquifer is the Passaic Formation, which is regionally classified as a NJDEP Class IIA aquifer.

The Passaic Formation is a semi-confined aquifer, separated from the overlying unconsolidated sequences by a low-permeability weathered bedrock surface consisting predominantly of silt and clay (residual soil and fluvial fines) that is estimated to be 5 to 10 ft thick.

The primary porosity of the bedrock is low. However, faulting, bedding, parallel parting, and jointing give rise to secondary porosity that is hydraulically significant. Wells intersecting zones that are highly fractured can sustain yields of hundreds of gal/min (BB&L 1995a). At least three zones of highly fractured bedrock have been identified at the site and are referred to as "the SS transmissive zone," "the highly transmissive zone," and "the moderately transmissive zone." These zones trend northeast-southwest and dip to the northwest at approximately 9.0°. This coincides with the orientation of the bedding of the Passaic Formation.

For the past 60 years, the Bound Brook facility has withdrawn water, from production wells which extend into this formation, for use as non-contact cooling water in production operations. In the 1982 ACO, Cyanamid agreed to continue to pump ground water at a rate not less than 650,000 gal/day. The ground water pumped is combined with the plant's production wastewater and pretreated by neutralization to meet NJPDES permit effluent limitations before being discharged to Somerset Raritan Valley Sewerage Authority (SRVSA) for subsequent treatment under an existing permit (SRVSA Permit No. 8A). Presently, the facility withdraws a minimum of 650,000 gal/day from the Passaic Formation for the purpose of controlling ground water at the site. These wells were formerly located on the Hill Property, but were relocated to the main plant area in accordance with approval from NJDEP. When these wells were brought on-line on March 23, 1994, the Hill Property production wells were shut off, although they continue to be used for ground water monitoring purposes.

Due to the effects of this pumping, bedrock ground water flows from the perimeter of the site inward towards the pumping wells (Exhibit E). This water is discharged to the SRVSA for treatment. Over 10 years of ground water monitoring at the site have confirmed that the ground water control system is effectively controlling the majority of the impacted bedrock ground water on the main plant and west yard areas of the site (CDM 1992: 4th Quarter of 1992 New Jersey Pollutant Discharge Elimination System/Discharge to Ground Water Permit Ground Water Monitoring Program). Overburden ground water in the unconsolidated overburden deposits which is not captured by the pumping system flows to the Raritan River. Based on overburden ground water data, ground water flowing to the Raritan River does not contain chemical constituents above regulatory standards.

Exhibit F of this report presents a more detailed technical discussion of the geology and hydrogeology in the contiguous area of Impoundments 3, 4, 5, and 26. This area was focused on as part of the evaluation of IPC alternatives for these four impoundments. Impoundments 1, 2, 14 and 20 were not evaluated for IPC and, therefore, are not included in the assessment.

2.3. Surface water hydrology

Raritan River. The southern boundary of the Bound Brook facility borders the Raritan River for approximately 1.5 miles. The site is approximately 20 miles upstream from the river mouth at the Atlantic Ocean. Flow data from the U.S. Geological Survey (USGS) gaging station at Calco Dam indicate a range of monthly average flows of 415 MGD to 1415 MGD for this non-tidal section of the river.

There is no potable use of river water for residential consumption downstream of the Bound Brook facility. The intake for the Elizabethtown Water Company is located upstream of the Bound Brook facility. The upstream sections of the river support a resident bass fishery, and recreational activities occur in the Raritan Bay area at the mouth of the river. Studies conducted prior to the submission of this report suggest that the Bound Brook facility has not had a measurable impact on water quality in the Raritan River upstream of the Calco Dam and above the Cuckolds Brook discharge to the river (BB&L 1995; BB&L 1994b DRAFT - under review by NJDEP and USEPA).

Cuckolds Brook. Cuckolds Brook, which traverses the site, is a tributary to the Raritan River. Historic information indicates that the course of Cuckolds Brook has been modified at least twice to accommodate the needs of the expanding manufacturing facilities. The confluence of the brook with the Raritan River is at the Calco Dispersion Dam on the river south of Impoundments 15 and 16.

Cuckolds Brook is classified by the NJDEP as an FW-2 non-trout stream (August 1994 Division of Water Resources Surface Water Quality Standards, NJAC 7:9B-1.15). The predominant flow in Cuckolds Brook is the approximate 12 MGD to 14 MGD discharge (dry weather flow) of secondary effluent from the SRVSA facility which is located immediately to the west of the Bound Brook facility. The SRVSA effluent enters the brook immediately west of Impoundments 4 and 26.

2.4. Baseline endangerment assessment overview

The Baseline Endangerment Assessment, which was approved by the regulatory agencies in 1992, provided an overall assessment of the potential human health and environmental risks posed by existing site conditions. A quantitative risk assessment was completed for affected media for which a complete human exposure pathway exists. A qualitative ecological assessment was also conducted to evaluate potential exposure pathways. As detailed in the Baseline Endangerment Assessment, only Impoundments 1 and 2 of the Group III impoundments were identified as having complete exposure pathways through which potential receptor contact could result in unacceptable risks. Each of the other Group III impoundments was determined to have incomplete exposure pathways or exposure pathways through which potential receptor contact would not pose unacceptable risks.

In the Baseline Endangerment Assessment, potential risks were evaluated based on an integrated analysis of three factors: contaminant concentration, toxicity, and exposure potential. In order for an exposure event to occur, a complete exposure pathway would be required. A complete exposure pathway would consist of a contaminant source and release mechanism, a retention or transport medium, a point of potential receptor contact with the contaminated medium, and an exposure route (e.g., ingestion or inhalation) at the contact point. Based on the findings of the Baseline Endangerment Assessment, Impoundments 3, 4, 5, 14, 20, and 26 do not pose an unacceptable risk to receptor populations identified in their current state. This conclusion is based on the following: Impoundments 3, 4, 5, 14, 20, and 26 are located within a secure operating facility (fenced and guarded), remote from potential off-site receptor populations; the bedrock ground water from the Group III impoundments area is captured by the on-site pumping wells; and dust or volatile emissions from the Group III impoundments do not have significant potential to reach receptor populations at concentrations that could impact human health or the environment.

However, the Baseline Endangerment Assessment calculated the volatile emissions from Impoundments 1 and 2 exclusively, because these impoundments contained significantly higher concentrations of volatile compounds than any other impoundment. A water cover is maintained on Impoundment 2 and a liner is maintained on Impoundment 1 to control the volatile emissions. Based on the calculations in the Baseline Endangerment Assessment, the potential cancer risk associated with emissions from Impoundments 1 and 2 was calculated to be 2.4×10^{-6}, slightly above the 1×10^{-6} risk guideline (BB&L 1994a).

While the Baseline Endangerment Assessment concluded there was limited potential for direct contact with the material in the Group III Impoundments, this material is a continuous source of ground water contamination. Ground water in the vicinity of the site is classified as 2A, which is defined as a potential source of drinking water, although it is not used as drinking water. Exposure to impacted ground water under a future ground water use scenario is an exposure pathway.

2.5. Natural resources assessment

The Natural Resource Assessment was completed in April 1994 (BB&L 1994b). The Natural Resource Assessment was a compendium of assessments for site natural resources including: wetlands, floodplains, cultural resources, endangered species, and the Raritan River. The April 1994 Natural Resource Assessment provided the following conclusions regarding the natural resources at the Bound Brook facility.

Resource	Assessment
Wetland	Wetlands at the site represent intermediate resource value with some open water basins of ordinary value. Wetland areas, with respect to the Group III impoundments, are primarily located adjacent to Impoundments 1, 2, 14, 20, and 26.
Floodplains	Two floodplains exist at the Bound Brook facility: the Raritan River Floodplain and Cuckolds Brook floodplain. The Raritan River Floodplain extends north and east from the river bank and encompasses the entire Bound Brook facility including the Cuckolds Brook Floodplain. A flood control dike isolates the manufacturing and west yard areas which include Impoundments 3, 4, 5, 14, 20 and 26. Areas outside the dike are susceptible to flooding.
Cultural Resources	The cultural resources survey concluded that the majority of the Bound Brook facility has been extensively altered for development; therefore it is unlikely that intact archaeological resources existed or remain.
Endangered Species	The endangered species evaluation concluded that there was no record of rare plants, animals or natural communities at the Bound Brook facility.
Raritan River	The Raritan River assessment concluded that surface water and sediment analytical results demonstrate that water quality meets the FW-2NT criteria (Non-trout freshwaters not designated as FW-1 wholly within protected areas and not subject to discharge of man-made wastes).

In January 1996, the Natural Resource Assessment Data Summary Report (O'Brien & Gere 1996a) summarized chemical monitoring data with respect to potential chemical migration pathways to natural habitats identified at the Bound Brook facility. This report was developed at the request of the Natural Resource Trustees based on their review of the April 1994 Natural Resources Assessment (BB&L 1994b). The January 1996 Natural Resources

Assessment Data Summary Report (O'Brien & Gere 1996a) made the following conclusions:

- The low quantity vegetative cover adjacent to the Raritan River is potentially used as a temporary corridor for migratory and transient species.

- Organic compounds detected in soils, sediments, or surface water originate from man-made sources; however, metals detected in those media are ubiquitous in the environment. Surface water, sediment, and surface soil/wetland sediment are media with potential for direct ecological contact.

Based on these conclusions, it is not anticipated that Impoundments 3, 4, 5, 14, 20, or 26 or immediately adjacent areas would be used by migratory and transient species since these impoundments are not situated adjacent to the Raritan River.

2.6. Characterization data

The location of the Group III impoundments is illustrated in Figure 2-2. mpoundments 3, 4, 5, 14, 20, and 26 are located within the flood control dike of the Main Plant area of the Bound Brook facility while Impoundments 1 and 2 are located south of the Port Reading Railroad tracks approximately 750 ft north of the Raritan River. Impoundments 3, 4, and 5 are clustered between the West Yard and Cuckolds Brook just south of Eighth Street. Impoundment 26 is located immediately north of Impoundment 4, just across Eighth Street. Impoundments 14 and 20 are located in the northern portion of the West Yard, in proximity to the current production area.

The history, physical and chemical characteristics of the impoundment materials, and the current condition of each impoundment are summarized below. For each Group III impoundment, predominant detected organic and metal constituent data are summarized in the following subsections. Throughout this report, general plant debris (and in particular oversized plant debris) is discussed. General plant debris that has been deposited in the impoundments includes: whole and crushed steel drums, concrete barriers, demolition debris, glass, etc. General plant debris can be found in Impoundments 3, 4, 5, 14, and 26.

2.6.1. Impoundment 1

Impoundment 1 is located south of the Port Reading Railroad tracks, approximately 750 ft north of the Raritan River. This 2.1 acre impoundment was constructed in 1956 and used until 1965 for the storage of sludges from the coal oil ("light oil") refining process. Between 1966 and 1967, the top layer of Impoundment 1, consisting of a light oil sludge (LOS) material, was removed, leaving only the more viscous layers. The remaining viscous material in Impoundment 1 forms two distinct layers: an upper viscous, rubbery (VR) tar layer and a lower layer of hard, crumbly (HC) tar. Impoundment 1 contains approximately 6,500 yd^3 of the VR layer at an estimated depth of 0 to 3 ft and approximately 13,000 yd^3 of the HC layer at an estimated depth of 3 to 8 ft. In the 1980's, coal aggregate was deposited into Impoundment 1 to facilitate the excavation of material for an off-site fuel blending program. This program was unsuccessful; however, coal deposits remain in the impoundment. Impoundment 1 is covered with a synthetic liner for odor control. The pH of Impoundment 1 is less than 1 s.u.

The ground water table beneath Impoundment 1 varies between 0 to 3 ft below the bottom of Impoundment 1. Reportedly the bottom of the impoundment is lined with a 12 inch clayey-silt layer. Soil analytical data has not been collected from beneath the bottom of Impoundment 1; however, split spoon samples collected from the northern and southern berms of Impoundment 1 indicated traces of leachate contamination (O'Brien & Gere 1982).

The following constituents are representative of the chemical composition of Impoundment 1 based on characterization analytical sampling (BB&L 1990). The Impoundment Characterization Program Final Report presents the complete analytical database.

Organic Compounds	Min	Max	Mean	Detects
Volatiles (ppm)				
Benzene	44,000	50,000	47,000	2 of 2
Toluene	12,000	17,000	15,000	2 of 2
Xylenes	2,400	30,000	16,000	2 of 2
Semivolatiles (ppm)				
1,2-Dichlorobenzene	530	1,600	1,100	2 of 2
Naphthalene	1,100	4,100	2,600	2 of 2
Nitrobenzene	430	4,800	2,600	2 of 2

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
arsenic	0.3	3.7	2.1	3 of 3
barium	ND	16.4	5.5	1 of 3
cadmium	ND	ND	ND	0 of 3
chromium	15.3	36.9	18.5	3 of 3
copper	20.3	34.8	28.4	3 of 3
lead	60.5	100.0	86.5	3 of 3
mercury	0.2	1.0	0.7	3 of 3
nickel	10.0	25.6	19.5	3 of 3
selenium	3.8	3.9	3.9	3 of 3
silver	ND	3.3	1.1	1 of 3
zinc	ND	9.3	3.1	1 of 3

Additional characterization data generated for Impoundment 1 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix A, separately bound as Volume 2. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Benzene	38,700
Toluene	101
Xylenes	1,760
Semivolatiles (ppm)	
1,2-Dichlorobenzene	310
Naphthalene	1,390
Nitrobenzene	365

2.6.2. Impoundment 2

Impoundment 2 is located south of the Port Reading Railroad tracks, approximately 750 ft north of the Raritan River. Impoundment 2 was constructed in 1947 and was used until 1956, at which time Impoundment 1 was constructed. This 2.3 acre impoundment was also used for the storage of sludges from the coal oil ("light oil") refining process. Between 1986 and 1987, the top layer of Impoundment 2, consisting of LOS, was removed, leaving non-pumpable sludges. The remaining material in Impoundment 2 forms two distinct layers: an upper VR tar layer and a lower layer of HC tar. Impoundment 2 contains approximately 12,000 yd^3 of the VR layer at an estimated depth of 0 to 4 ft and approximately 12,000 yd^3 of the HC layer at an estimated depth of 4 to 9 ft. Impoundment 2 is covered with a water cover for odor control. The pH of Impoundment 2 is less than 1 s.u.

The ground water table beneath Impoundment 2 varies between 0 to 3 ft below the bottom of Impoundment 2. Reportedly the bottom of the impoundment is lined with a 12 inch clayey-silt layer, similar to Impoundment 1. Soil analytical data has not been collected from beneath the bottom of Impoundment 2; however, split spoon samples collected from the southern and western berms of Impundment 2 indicated traces of leachate contamination (O'Brien & Gere 1982).

The following constituents are representative of the chemical composition of Impoundment 2 based on characterization analytical sampling. The Impoundment Characterization Program Final Report (BB&L 1990) presents the complete analytical database.

Organic Compounds	Min	Max	Mean	Detects
Volatiles (ppm)				
Benzene	4,700	9,000	6,900	2 of 2
Toluene	2,700	4,600	3,700	2 of 2
Semivolatiles (ppm)				
1,2-Dichlorobenzene	910	3,100	2,000	2 of 2
Naphthalene	5,200	21,000	13,000	2 of 2

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
arsenic	4.2	24.4	13.1	3 of 3
barium	18.0	62.3	31.5	3 of 3

Inorganic Compounds	Min	Max	Mean	Detects
cadmium	ND	ND	ND	0 of 3
chromium	7.3	11.4	9.9	3 of 3
copper	19.6	29.8	24.3	3 of 3
lead	99.5	127.0	116.8	3 of 3
mercury	1.1	2.6	1.7	3 of 3
nickel	ND	9.1	3.0	1 of 3
selenium	8.6	13.8	10.9	3 of 3
silver	ND	ND	ND	0 of 3
zinc	10.0	21.5	14.3	3 of 3

Additional characterization data generated for Impoundment 2 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix A . A summary of these additional data is presented as follows:

Organic Compounds	Min	Max	Mean	Detects
Volatiles (ppm)				
Benzene	33,000	61,000	45,800	3 of 3
Toluene	5,660	16,200	10,200	3 of 3
Semivolatiles (ppm)				
1,2-Dichlorobenzene	1,000	2,210	1,410	3 of 3
Naphthalene	3,460	9,860	6,020	3 of 3

2.6.3. Impoundment 3

This 1.3-acre, 14 to 18 ft deep impoundment was constructed in 1943 and operated until 1975. It was initially used for the storage of organic tars from the distillation of coal oil. Construction material, general plant debris, and fill material were also consolidated into the impoundment at a later time, resulting in an area that is three-quarters covered with fill/soil. Some of the plant material included sludges generated by the former dyes/pigments operations conducted at the facility. The impoundment contains a total of approximately 21,000 yd^3 of well-mixed organic tar, fill material, and general plant debris.

The northwest corner of the impoundment, known as the "wet" portion, contains approximately 2,500 yd^3 of primarily organic tar material. The remainder of the impoundment, known as the "dry" area, contains a mixture of black tar, various demolition wastes (wood, concrete, and steel), whole and crushed steel drums, cloth, glass, and miscellaneous plant waste including organic sludges. Most of the "dry" portion of the impoundment supports sparse vegetative growth.

The following constituents are representative of the chemical composition of the impoundment based on characterization analytical sampling conducted on both fill and tar material within Impoundment 3 (BB&L 1990). Exhibit G presents the analytical database prior to supplemental treatability studies.

Organic Compounds	Min.	Max.	Mean	Detects
Volatiles (ppm)				
Benzene	44	1,000	300	5 of 5
Toluene	15	370	150	5 of 5
Semivolatiles (ppm)				
1,2-Dichlorobenzene	18	370	180	5 of 5
2-Methylnaphthalene	58	290	170	5 of 5
Naphthalene	720	890	800	5 of 5

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
antimony	ND	17.4	10.7	3 of 5
arsenic	0.9	10.3	5.4	7 of 7
barium	115	592	265	5 of 5
beryllium	ND	0.94	0.66	3 of 5
cadmium	ND	5	3.5	3 of 7
chromium	64	1540	369	7 of 7
copper	28	812	281	7 of 7
cyanide	ND	312	130	5 of 7
lead	66.6	4480	924	7 of 7
mercury	0.09	2	1.2	7 of 7

Inorganic Compounds	Min	Max	Mean	Detects
nickel	21	65.9	39.5	7 of 7
selenium	ND	0.72	0.4	4 of 7
silver	ND	29.3	5.2	2 of 6
vanadium	27.8	42.2	36	5 of 5
zinc	81	2470	598	7 of 7

Additional characterization data generated for tar material within Impoundment 3 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix B, separately bound as Volume 3. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Benzene	36,000
Toluene	9,100
Semivolatiles (ppm)	
1,2-Dichlorobenzene	6,100
2-Methylnaphthalene	1,300
Naphthalene	11,000

2.6.4. Impoundment 4

This 1-acre impoundment was constructed in 1943 and operated until 1975. It was used to store organic tars from various production processes. Although it originally contained between 7 and 9 ft (approximately 13,500 yd^3) of a tacky, stringy tar that increased in viscosity with depth, it now contains only an estimated 1,000 yd^3. The Fuel Blending/Recycling Program was successful in removing approximately 12,500 yd^3 of the original tars. The surface of Impoundment 4 is covered by an aqueous layer attributable to rainfall.

The following constituents are representative of the chemical composition of the impoundment based on characterization analytical sampling (BB&L 1990). Exhibit G presents the analytical database prior to supplemental treatability studies.

Organic Compounds	Min.	Max.	Mean	Detects
Volatiles (ppm)				
Benzene	2,900	20,000	13,000	3 of 3
Toluene	710	6,100	3,600	3 of 3
Semivolatiles (ppm)				
1,2-Dichlorobenzene	ND	8,200	2,800	2 of 3
Naphthalene	330	20,000	11,000	3 of 3
Nitrobenzene	ND	1,300	530	2 of 3

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
arsenic	ND	101	35	3 of 5
cadmium	3	4	3.5	2 of 2
chromium	ND	14	4	2 of 5
copper	ND	20.3	9.3	4 of 5
lead	ND	65	24.6	4 of 5
mercury	ND	0.87	0.33	4 of 5
nickel	ND	5.4	1.5	2 of 5
selenium	ND	1.9	0.75	4 of 5
zinc	ND	35.1	17.6	4 of 5

Additional characterization data generated for Impoundment 4 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix B. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Benzene	21,000
Toluene	3,100

Organic Compounds	Concentration
Xylenes	1,000
Semivolatiles (ppm)	
1,2-Dichlorobenzene	1,700
Naphthalene	2,000

2.6.5. Impoundment 5

Impoundment 5, like Impoundments 3 and 4, was constructed in 1943 and used until 1975. This 7.7 acre impoundment, with a total average depth of approximately 12-ft, initially stored sludges from on-site manufacturing activities. Later, organic tars, also generated from manufacturing activities at the site, were added to the impoundment. In the 1960s and 1970s, fill material, general plant material, drums, and construction material were also added. The filling activities resulted in the impoundment becoming divided, almost equally, into a "wet" (eastern) and "dry" (western) area. The dry area is made up of the solid fill materials, and the wet area is tars and sludges. It should be noted that the sludges underlie the fill materials, and thus cover the entire bottom of the impoundment, not just that of the "wet" area.

The "wet" portion was originally covered by a 2.5-ft layer of stringy tar material, which increased in viscosity with depth. The estimated volume of this material was 13,000 yd^3, of which approximately 6,200 yd^3 were removed as part of the fuel blending program. Therefore, there is currently 6,800 yd^3 of tar remaining. The "dry" portion of the impoundment contains approximately 35,500 yd^3 of mixed fill material consisting primarily of soil, construction material (pieces of wood, portions of concrete slabs, steel, and bricks), whole and portions of deteriorated steel drums, and large stones. In effect, when it was decided to place fill materials in the impoundment, there already existed a layer of sludge across the bottom. Thus in the "dry" portion, the fill material covers the sludge. In the "wet" area, the tar and sludge remain exposed.

Beneath the tar in the "wet" area, and beneath the fill in the "dry" area, is a 7-ft deep layer of black, tacky, sludge. This material, which covers the bottom of the impoundment, is approximately 68,000 yd^3 in volume. Of the 68,000 yd^3 of sludge, approximately 20,400 yd^3 is under the mixed fill, "dry" layer, and the remaining volume is considered in the "wet" area.

The total original volume was approximately 116,500 yd^3. After completion of the fuel blending program, 110,300 yd^3 remain in Impoundment 5.

The following constituents are representative of the chemical composition of the impoundment based on characterization analytical sampling of the black sludge material (BB&L 1990). Exhibit G presents the analytical database prior to supplemental treatability studies.

Organic Compounds	Min.	Max.	Mean	Detects
Volatiles (ppm)				
Benzene	25	82,000	10,000	9 of 14
Toluene	69	35,000	4,800	9 of 14
Xylenes	62	28,000	3,500	9 of 14
Semivolatiles (ppm)				
Benzo(a)anthracene	32	20000	120	7 of 14
2-Methylnaphthalene	19	8,100	3,700	9 of 14
Naphthalene	3,300	420,000	58,000	9 of 14
Nitrobenzene	540	54,000	10,000	9 of 14
n-Nitrosodiphenylamine	180	14,000	4,400	9 of 14

Inorganic Compounds	Sludge				Fill			
	Min	Max	Mean	Detects	Min	Max	Mean	Detects
Metals (ppm)								
antimony	ND	22	4.4	3 of 9	ND	6.5	1.63	1 of 4
arsenic	6.3	63	29.0	9 of 9	1	16.5	9	4 of 4
barium	102	7,480	2,502	9 of 9	63.8	229	115	4 of 4
beryllium	ND	1.6	0.99	2 of 9	ND	2.1	0.53	1 of 4
cadmium	ND	9.3	5.4	8 of 9	ND	0.85	0.21	1 of 4
chromium	32	3,680	1,500	9 of 9	57.4	863	359	4 of 4
copper	163	3,020	1,894	9 of 9	124	233	190	4 of 4
cyanide	ND	51.3	26.0	7 of 9	ND	9.6	2.4	1 of 4
lead	50	2,930	1,314	9 of 9	54.8	440	254	4 of 4
mercury	5	199	82.3	9 of 9	0.79	4.3	2.1	4 of 4
nickel	53	464	225	9 of 9	10.8	316	110	4 of 4

Inorganic Compounds	Sludge				Fill			
	Min	Max	Mean	Detects	Min	Max	Mean	Detects
selenium	ND	6.10	2.0	8 of 9	ND	0.8	0.61	3 of 4
silver	ND	3.90	3.30	6 of 9	NA	NA	NA	NA
vanadium	3	71	34.6	9 of 9	6	31	20.6	4 of 4
zinc	115	3,190	837	9 of 9	141	2,130	838	4 of 4

Additional characterization data generated for sludge material within Impoundment 5 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix B. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Benzene	780
Toluene	3,000
Xylenes	2,200
Semivolatiles (ppm)	
Benzo(a)anthracene	360
2-Methylnaphthalene	12,000
Naphthalene	240,000
Nitrobenzene	1,600
n-Nitrosodiphenylamine	3,100

2.6.6. Impoundment 14

Impoundment 14 was constructed in 1954 and operated until 1958. It was used for the storage of organic tars. Sludges and general plant debris were disposed of in the impoundment at a later time. It has a surface area of approximately 0.9 acre, is 4 to 5 ft deep, and contains approximately 5,000 yd^3 of a mixture of stringy organic tar, organic sludge, and general solid wastes. A water layer covers the surface of the impoundment and varies in depth with rainfall. Small trees and other vegetation are rooted in the berms around the impoundment.

The following constituents are representative of the chemical composition of the impoundment based on characterization analytical sampling (BB&L 1990). Exhibit G presents the analytical database prior to supplemental treatability studies.

Organic Compounds	Min.	Max.	Mean	Detects
Volatiles (ppm)				
Benzene	610	1,300	960	2 of 2
Chlorobenzene	1,400	3,200	2,300	2 of 2
Toluene	1,200	1,300	1,300	2 of 2
Xylenes (total)	920	1,400	1,200	2 of 2
Semivolatiles (ppm)				
Naphthalene	ND	7,800	3,900	1 of 2
Nitrobenzene	ND	1,600	800	1 of 2

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
antimony	ND	33	17	1 of 2
arsenic	ND	101	26	3 of 4
beryllium	ND	0.3	0.15	1 of 2
cadmium	ND	5	2.1	3 of 4
chromium	11	310	86	4 of 4
copper	40	730	371	4 of 4
lead	46.4	650	267	4 of 4
mercury	ND	40	17.6	3 of 4
nickel	4	68	36	4 of 4
selenium	0.02	2.4	0.62	4 of 4
silver	ND	0.3	0.075	1 of 4
zinc	81	810	458	4 of 4

Additional characterization data generated for Impoundment 14 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix B. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Benzene	350
Chlorobenzene	2,200
Toluene	820
Xylenes	840
Semivolatiles (ppm)	
Naphthalene	36,000
Nitrobenzene	8,500
N-Nitrosodiphenylamine	21,000

2.6.7. Impoundment 20

Impoundment 20 was constructed in the early 1950s and used until 1980 as a settling basin for the on-site treatment of wastewater generated from former dye and pigment operations. In 1986, the contents of Impoundment 20 were subjected to a partial *in situ* solidification process using a mixture of cement kiln dust and Portland cement. After *in situ* solidification was completed, the surface of the impoundment was covered with a 6-mil synthetic liner and graded with approximately 1 ft of clean fill.

Impoundment 20 is approximately 1 acre in area and contains 7,800 yd^3 of a sludge/cement/kiln dust blend with an average depth of about 6.5 ft. The material in the impoundment is fairly homogeneous, with some variation in consistency due to incomplete mixing that apparently occurred during the *in situ* solidification process.

The following constituents are representative of the chemical composition of the impoundment based on characterization analytical sampling (BB&L 1990). Exhibit G presents the complete analytical database prior to supplemental treatability studies.

Organic Compounds	Min.	Max.	Mean	Detects
Volatiles (ppm)				
Benzene	1,600	5,500	3,600	3 of 3
Chlorobenzene	250	3,000	1,500	3 of 3
Xylenes	960	2,900	1,800	3 of 3

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
antimony	28	663	391	3 of 3
arsenic	6.26	8.4	7.33	2 of 2
barium	38.6	40.5	39.6	2 of 2
beryllium	1.3	1.36	1.3	2 of 2
cadmium	1.5	2.03	1.91	3 of 3
chromium	1500	58,400	34,033	3 of 3
copper	1600	8270	5737	3 of 3
cyanide	2.6	2.72	2.66	2 of 2
lead	1000	1880	1480	3 of 3
mercury	0.27	1.18	0.85	3 of 3
nickel	240	462	379	3 of 3
selenium	0.03	1.36	0.9	3 of 3
silver	0.2	2.72	1.84	3 of 3
vanadium	100	107	104	2 of 2
zinc	13,800	148,000	80,900	2 of 2

Additional characterization data generated for Impoundment 20 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix B. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Benzene	5,200
Chlorobenzene	4,100
Xylenes	5,500

2.6.8. Impoundment 26

Impoundment 26 was constructed in 1943 and used until 1955 for the storage of organic tars. It was later filled with construction material, general plant material, and fill material. Impoundment 26 is 1.3 acres in surface area, has an average depth of approximately 14-ft, and contains approximately 22,000 yd^3 of tar mixed with fill material and general solid wastes. About two-thirds of the surface of this impoundment is fill, while the remainder consists of exposed organic tar material mixed with general solid wastes and plant waste. The majority of tar (mixed with fill) is hard and brittle, and it is often found in various-sized chunks. The viscosity of the tar decreases with temperature; warm weather sometimes causes tar seeps near the surface.

The following constituents are representative of the chemical composition of the impoundment based on characterization analytical sampling (BB&L 1990). Exhibit G presents the analytical database prior to supplemental treatability studies.

Organic Compounds	Min.	Max.	Mean	Detects
Volatiles (ppm)				
Benzene	0.04	330	85	4 of 4
Toluene	0.02	1,400	480	3 of 4
Semivolatiles (ppm)				
Benzo(a)anthracene	5.20	660	330	4 of 5
Naphthalene	26	170	68	4 of 5
n-Nitrosodiphenylamine	26	450	150	4 of 5

Inorganic Compounds	Min	Max	Mean	Detects
Metals (ppm)				
antimony	7.7	43.9	26.2	4 of 4
arsenic	2.1	43.9	21.0	6 of 6
barium	3.4	43.9	1789	4 of 4
beryllium	ND	0.6	0.60	1 of 4
cadmium	7.7	51.2	21.6	6 of 6
chromium	55	266	149	6 of 6
copper	530	5290	2106	6 of 6
cyanide	ND	2.3	1.9	3 of 4
lead	668	38,200	7,770	6 of 6
mercury	2.1	16.8	5.4	6 of 6
nickel	58.3	829	284	6 of 6
selenium	1.4	7.6	2.1	4 of 6
silver	3.7	21.7	10.7	6 of 6
vanadium	17.1	61.9	42.4	4 of 4
zinc	860	5820	2623	6 of 6

Additional characterization data generated for Impoundment 26 as part of the supplemental treatability testing program conducted in 1995 and 1996 are presented in Appendix B. A summary of these additional data is presented as follows:

Organic Compounds	Concentration
Volatiles (ppm)	
Toluene	7
Semivolatiles (ppm)	
1,2-Dichlorobenzene	79
Benzo(a)anthracene	490
Naphthalene	45
n-Nitrosodiphenylamine	37

2.6.9. Summary and impoundment materials categories

The eight Group III impoundments cover a total of more than 17 acres. Originally they contained approximately 229,300 yd^3 of mixed waste materials. Approximately 10% of this waste, or 18,700 yd^3, was removed and recycled as part of the fuel blending/recycling program. The total current volume is, therefore, approximately 210,600 yd^3. The impoundment volumes are summarized below.

Impoundment	Before fuel blending/recycling volume (yd^3)	After fuel blending/recycling volume (yd^3)
1	19,500	19,500
2	24,000	24,000
3	21,000	21,000
4	13,500	1,000
5	116,500	110,300
14	5,000	5,000
20	7,800	7,800
26	22,000	22,000
Total	229,300	210,600

The heterogeneous chemical and physical makeup of several of the impoundments, as evidenced by the presence of general plant debris and fill in Impoundments 3, 4, 5, 14, and 26, was the reason that, in January 1992, a field pilot study was conducted (BB&L 1992c). This program evaluated screening to separate general solid wastes from fill, tar or sludges in Impoundments 3, 5, and 26. In addition to providing useful information regarding the development of remedial alternatives, it also helped to expand the physical characterization database for these impoundment materials. Relevant information from this study is summarized in a report and is incorporated into the discussion and development of remedial alternatives in Section 6.

These impoundments have been subdivided into separate material categories within this CMS/FS based on physical characteristics and material handling properties. By categorizing common materials within the Group III impoundments, a more consistent treatment evaluation can be conducted for each material category. The categorization is also more adaptable to full-scale remediation.

The material categories presented on Table 2-1 have been developed based on material types, physical handling properties, and existing analytical characterization. The following summarizes the impoundment categories:

- Category A - High Btu tar (Impoundments 1 and 2)
- Category B - Low Btu tar/sludge (Impoundments 4, 5 (wet), 14, and 20)
- Category C - Impoundment 3
- Category D - Non-hazardous material (Impoundments 5 (dry) and 26)
- Category E - General plant debris (Impoundments 3, 4, 5, 14, and ~~20)~~. 26

Category D was developed to include the non-hazardous material in the Group III Impoundments, primarily Impoundment 5 (dry) and 26. Materials in Impoundments 5 (dry) and 26 have been categorized as non-hazardous material for the purpose of the CMS/FS based on previous NJDEP classification (Schiffman 1990, 1991) and data (BB&L 1995). Additional sampling and analyses may be necessary to verify the classification during the remedial design phase.

Table 2-1 presents a breakdown of the material categories, a detailed description of the material, material volumes, the historical use of the impoundments, and other miscellaneous information. The evaluations presented in this CMS/FS Report are based on the material classifications and not individual impoundment references.

3. Identification and screening of technologies

The first phase of the CMS/FS is the development of remedial alternatives which includes the identification and screening of technologies. The objective of the identification and screening of technologies is to develop a range of potential technically implementable remedial technologies for the Group III impoundment materials which can meet remedial objectivesand which are protection of human health and the environment. The steps in this process include the following:

- development of RAOs
- identification of general response actions
- estimation of volumes and areas of media
- identification of potentially applicable remedial technologies
- screening of technologies with respect to technical implementability.

Technologies which are identified to be technically implementable are further evaluated with respect to effectiveness, implementability, and cost in Section 4, at which point technologies are selected for remedial alternative assembly in Section 6.

3.1. Remedial action objectives

RAOs are goals for protection of human health and the environment at a site which are identified for specific environmental media or operable units. RAOs are based on constituents of concern, exposure or migration pathways, and preliminary remediation goals. USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988b) specifies that preliminary remediation goals be based on readily available risk information and ARARs, but that final remedial actions be based on baseline risk assessment results and the exposure and risk evaluations for remedial alternatives.

The Baseline Endangerment Assessment was conducted to evaluate potential risks associated with the impoundments at the site in their current state. The Baseline Endangerment Assessment concluded that the potential excess cancer risk associated with volatile organic emissions from the water covers from Impoundments 1 and 2, 2.4×10^{-6}, was slightly above USEPA's risk guideline of 1×10^{-6}. It was also concluded that the other Group III impoundments did not pose an unacceptable risk to identified receptors.

As discussed above, ARARs must be considered in addition to risk information in establishing preliminary remediation goals; chemical-specific ARARs are therefore considered during RAO development. The Group III impoundment materials are the only media addressed by this CMS/FS; other site media are addressed as separate operable units for the Bound Brook site. Potential chemical-specific ARARs for the Group III impoundment materials were not identified.

The following RAO has been developed for the Group III impoundments based on migration pathway and exposure pathway considerations:

- Eliminate the migration of constituents from the Group III impoundments, to air, soil, ground water and surface water at levels representing an unacceptable human health or environmental risk or resulting in exceedances of ARARs.

3.2. General response actions

Following the development of RAOs, the next step in the CERCLA process is the identification of general response actions which will address the Group III impoundment materials and the RAOs. General response actions are categories of remedial actions. General response actions encompass various technologies, which are later identified during the CERCLA process. General response actions which address the RAOs for the Group III impoundment materials include:

- containment actions
- removal actions
- treatment actions
- disposal actions.

Technologies addressed by these general response actions are discussed in Section 3.4, following the identification of volumes and areas of impoundment material to be addressed by each general response action.

3.3. Volumes and areas of media

RAOs and identified general response actions are considered to identify the volume and area of material to be addressed in the CMS/FS. A summary of the estimated areas and volumes of each Group III impoundment material type is presented in Table 2-1. For impoundment removal actions. Impoundment 1 and 2 contents and underlying soil would be removed to the ground water level. For the remaining Group III Impoundments, impoundment materials and 6 inches of underlying soil would be removed. The volume of soil to be removed was included in the total volume estimate for each impoundment. Investigation and management of the soils remaining after the removal actions will be the subject of a separate operable unit, as specified in the ACO.

For the purposes of these estimates, it was assumed that the underlying soil to be removed with the impoundment materials would have relatively similar characteristics to the materials overlying it and was subsequently not included as a separate material category.

3.4. Identification and screening of remedial technologies

The identification and screening of technologies for the Group III impoundments is documented in the 1991 CMS/FS Work Plan (BB&L 1991a). That screening effort indicated that the following technologies were potentially applicable for the Group III impoundment materials:

- bioremediation
- thermal treatment
- solidification
- fuel blending/recycling
- in-place containment (IPC).

This CMS/FS is based on the disposal location of the Group III impoundment material to be on-site within the Impound 8 facility. For this reason, technology comprising placement within Impound 8 has also been included in the following evaluation. Off-site disposal was evaluated only with respect to non-hazardous impoundment material.

General descriptions of each of these technologies are presented in the following sections. The evaluation of each of these as alternatives is documented in Section 4.

3.4.1. Consolidation in Impound 8

Consolidation in Impound 8 entails physical conditioning of materials as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility. This facility is a state-of-the-art, triple-lined hazardous waste management facility. It has been designed, constructed, and operated in accordance with a hazardous waste permit. Conditioning would include the addition of agents such as Portland cement, sodium silicate and moisture. During conditioning, off-gas control may be used to control residual organic vapors or particulate matter.

Placement of material in the Impound 8 facility must be performed with consideration given to the potential for damage of the non-woven geotextile filter media at the top of the primary leachate layer. Based on a debris placement evaluation presented in Appendix C, no size restrictions are proposed for placement of rocks and debris in Impound 8. The recommended placement procedure for debris should limit placement to no closer than 2-ft from any geotextile, geomembrane, or geosynthetic material, and debris should not be placed above the sideslopes.

3.4.2. Bioremediation

Bioremediation is a remedial process that uses naturally occurring or specially cultivated microorganisms to digest and breakdown organic contaminants into simpler components under manipulated environmental conditions. Biological processes can remediate organic substances in soil, water, air, sediment and waste treatment residuals. Bioremediation technologies may be applied to solid-phase, aqueous-phase, and vapor-phase media. Based on previous studies, solid-phase technology was concluded to be more implementable and cost-effective than slurry-phase technology for Group III Impoundment materials (Shah 1995). The NJDEP directed Cyanamid to conduct field scale solid-phase bioremediation pilot testing for Impoundments 3, 4, 5, 14, 20 and 26 to aid in establishing treatment objectives. This testing was conducted by O'Brien & Gere in 1995 and 1996.

The bioremediation treatment that was piloted simulated aerated pile treatment. Sludge or solid-phase media is layered in lifts with aeration piping. Typically the pile is covered, and air inlet ports are provided. Air is pulled (or pushed) through the pile and, generally, collected in a common exhaust discharge. Discharged air may require treatment. Nutrients are provided in solid or liquid form. In the former case, fertilizer is blended with the feed prior to constructing the pile; in the latter case, nutrients are added using spray or drip irrigation methods intermittently throughout the operation. The system tested provides advantages of maximum treatment for minimum space usage, emission control capabilities and overall volume reduction of contaminated material. The fine particle size material encountered required the addition of a detackification agent, such as hay, straw, cured compost, woodchips, sawdust, or sand, which is used to provide or improve the texture, structure and porosity of the compost mixture. The detackification agent can also be used to lower the moisture content of the compost to the desired level and in some cases can also serve as an additional carbon source to supplement the contaminant load.

Compost core temperature is typically elevated (1 to 7° higher than periphery), providing the benefit of improved kinetics and year round efficiency. Treatment within a period of three weeks was shown to be effective for the materials tested.

The results of the pilot-scale testing performed in 1995 and 1996 by O'Brien & Gere are presented in Appendix B and discussed in Section 5.

3.4.3. Thermal treatment

The NJDEP directed Cyanamid to conduct further thermal treatment testing for Impoundments 1 and 2 to aid in establishing treatment objectives (Shah 1995). This testing was based on LTTT technologies. The following is a description of the LTTT testing that was conducted.

Pretreatment. Pretreatment was found to be necessary to condition and detackify the material prior to processing in a LTTT system. Pretreatment was also found to remove VOCs and SVOCs from soils or sludges by use of mixing equipment, controlled volatilization, and thermal desorption. For this reason, the pretreatment step for Impoundments 1 and 2 is referred to as thermally-enhanced mechanical desorption (TEMD). The technology can be implemented during material conditioning, where the addition of conditioning agents occurs for subsequent materials handling, treatment, or disposal. TEMD utilizes a combination of two mass transfer mechanisms:

- *Volatilization,* whereby the material is processed in a pug mill or similar mixing device where VOCs and SVOCs are released through the mixing process and subsequently collected by various vapor control devices.

- *Thermally-enhanced desorption,* whereby heat generated by the process assists in the volatilization of VOCs or SVOCs. Heat generation can be accomplished by chemical reaction with the conditioning agent (heat of hydration from neutralization), mechanical friction, or by use of heated process equipment.

TEMD was evaluated during the pilot testing of sludges from Impoundments 1 and 2. The TEMD process evaluation included the mixing of sludge with Portland cement (Phase I), followed by mixing in a pugmill with limestone aggregate (Phase II). The addition of Portland cement served three purposes: detackification, neutralization, and heat generation through hydration. Detackification and neutralization are necessary for subsequent materials handling and thermal treatment. During neutralization, heat is generated which assists in the removal of VOCs and SVOCs from the waste matrix during mixing.

During Phase II, limestone aggregate was added to the Phase I conditioned sludge in a pugmill. The limestone aggregate further enhanced the mixing of the sludge with the Portland cement, maintained pH neutralization, and allowed further organic compound volatilization of the sludge.

During both Phase I and Phase II conditioning, the VOCs and SVOCs are desorbed from the sludge into the vapor phase. Off-gas control can consist of a variety of air pollution control technologies, such as condensation, carbon adsorption, or thermal oxidation. Gas scrubbing and particulate control may also be necessary for inorganic acid gases and particulates that may be evolved during processing.

The potential advantages of TEMD were realized during the preconditioning of Impoundment 1 and 2 sludges for subsequent LTTT. During the TEMD processing, temperatures of 100 to 150° F were attained, and laboratory results revealed that in some instances, up to 99% of VOCs and SVOCs were removed.

Low temperature thermal treatment. LTTT is a technology used to remediate VOCs and SVOCs in soils or sludges by increasing the material temperature to volatilize the organics. The vapors generated during LTTT can be collected by various methods, such as condensation followed by adsorption, and treated before release, such as by thermal oxidation. LTTT is effective for the range of VOCs and SVOCs found in Impoundments 1 and 2.

LTTT can be implemented by a number of types of equipment that usually apply direct or indirect heat to the organic materials. Typically, operation is in the 200 to 600° F range. Generally, the minimum heat supplied is necessary to remove the moisture from the waste matrix being treated. Water, VOCs and SVOCs are separated from the solids in the thermal desorption unit, often with the assistance of a purge gas (nitrogen, combustion gas, or other inert gas). After the separated gas exits the thermal desorber unit, it is collected and treated to remove the volatile fraction.

LTTT is especially advantageous when there are large quantities of excavated soil or sludge, because it can be readily operated on a continuous basis. Preconditioning is necessary to enhance materials handling, control pH and Btu loading, and remove free liquids.

The LTTT testing in 1995 and 1996 was conducted under aerobic and anaerobic conditions. The results of this testing are presented in Appendix A and are summarized in Section 5.

On-site incineration. There are various types of incineration technologies available including rotary kiln, liquid injection, multiple hearth, fluidized bed, molten salt, high temperature fluid wall, plasma arc torch, infrared thermal treatment, and vertical tube. Incineration would be carried out on-site. A mobile, on-site incinerator would be used and is comprised of the same unit operations as permanent commercial facilities, namely: combustion chambers, feed systems, bottom and fly ash handling units, air emissions controls, heat exchangers, and exhaust stacks. Incinerators operate continuously, but throughput and operating temperatures vary.

Incineration is a technically proven technology for the remediation of wastes containing VOCs and SVOCs. Of the remedial technologies presented in the CMS/FS, incineration is considered the only technology which is capable of achieving UTS for these compounds.

3.4.4. Solidification

Solidification is an effective technology for treatment of inorganic compounds and is applicable for a wide variety of materials, which may include soil, sludge, tar, and solid wastes. It is generally used to immobilize inorganic constituents in the waste material by using additives and binders, such as cement. The additives and binders can be mixed with the waste material *in situ* or *ex situ*. Solidification adds strength and reduces the mobility of contaminants, but generally does not destroy them.

Treatment by solidification for Group III materials could immobilize inorganic constituents and reduce the mobility of organic constituents in a single processing step. Solidification usually does not produce any waste streams requiring further treatment. Solidification of residual waste streams from other treatment technologies, such as thermal or biological, is often used to add strength prior to ultimate disposal of the waste in a landfill.

The best mixture of additives and binders for a specific waste can be determined by a bench-scale treatability study. For example, high concentrations of organic compounds in the waste material may have an inhibiting effect on the curing process and final quality of the solidified waste, making it necessary to try different mixtures in order to achieve acceptable results.

3.4.5. Fuel blending/recycling

Fuel blending/recycling involves the beneficial reuse of impoundment materials. Recycling of tars in Impoundments 4 and 5 was discussed in Section 2. The recycling option is potentially available for the remaining tars in Impoundments 4 and 14. Recycling can also be considered as part of a process option for the other treatment technologies. For example, solid or liquid residuals from LTTT may be taken off-site for use as a supplemental fuel source in certain industrial processes.

3.4.6. In-place containment

IPC is a grouping of technologies that, when combined, effectively can control the potential migration of contaminants to the environment. This technology provides a level of protection comparable to a "new," engineered landfill. IPC technologies control and manage the contaminants without the need to remove, handle or re-landfill the waste materials. The primary approach to IPC is to engineer a "barrier" around waste materials to isolate or disengage the contaminants from the environment. The "barrier" is an engineered structure consisting, for example, of a landfill cap ("top"), slurry walls and sheet piling ("sides"), and horizontal wells ("bottom").

An engineering study of this technology was conducted because of the large volume of landfill-like material and solid wastes in Impoundments 3 and 5, and the number of applicable technology alternatives to engineer an IPC structure. The engineering study (BB&L 1995b) is presented in Exhibit E, separately bound as Volume 4.

3.4.7. Off-site disposal

Off-site disposal involves transportation of material to a commercial landfill facility for disposal. This technology is included for evaluation with respect to non-hazardous impoundment material.

4. Evaluation of technologies

Remedial technologies which remained from the initial screening performed in the CMS/FS Work Plan, are further evaluated with respect to the criteria of effectiveness, implementability, and cost in accordance with the CERCLA process. These technologies are evaluated for each of the Group III impoundment material categories identified in Section 2.6.9. Effectiveness, implementability, and cost evaluations reflect consideration of the ultimate disposal of the Group III impoundment materials in the Impound 8 facility. Based on the results of this evaluation, technologies have been selected for each material category.

4.1. Evaluation of technologies

The technologies identified in the CMS/FS Work Plan as potentially applicable are evaluated with respect to effectiveness, implementability, and relative cost in this section. Evaluation with respect to effectiveness includes consideration of the technology's ability to meet RAOs (in conjunction with placement into Impound 8), potential effects on human health and the environment, and the technology reliability. The implementability evaluation addresses technical, as well as administrative, feasibility of the technologies. Finally, capital costs relative to the other technologies are evaluated for comparative purposes.

4.2. Selection of representative technologies

The evaluation and selection of technologies is presented below with respect to categorized material groups: Category A - High Btu tar; Category B - Low Btu tar/sludge; Category C - Impoundment 3 material; Category D - Non-hazardous material; and Category E - General plant debris. Based on the evaluation, the most favorable technologies were chosen for each material category.

4.2.1. Category A: High Btu tar

Consolidation in Impound 8. Consolidation in Impound 8 was chosen as an appropriate technology as it meets the RAO through placement in a secure, triple-lined waste management facility. It is readily implementable as long as appropriate air pollution control is provided during strength conditioning.

If this technology were implemented for the high Btu tar, it would require a medium capital investment relative to the other technologies screened.

Bioremediation. Bioremediation was not chosen as an appropriate technology for this material based on the limited effectiveness of bioremediation due to the low pH (<1.0) of the tar material inhibiting microbial activity (BB&L 1991a). Based on this, it does not offer any significant advantages over placement in Impound 8. If bioremediation were implementable for the high Btu tar it would require a medium capital investment relative to the other technologies screened.

LTTT. LTTT was chosen as an appropriate technology for this material since it would reduce levels of organic constituents and is readily implementable. LTTT would meet the RAO since the material would be removed from the impoundments, treated, and placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact with the material. Treatment would lower the risk through a reduction in contaminant levels. The results of the 1995 and 1996 treatability testing, described in Section 3.4.3 and presented in Appendix A, concluded that LTTT is a proven and reliable technology for reducing organic constituents in the high Btu tar. The results of the 1995 and 1996 LTTT treatability testing also indicated that LTTT would be readily implementable for the high Btu tars if preconditioning was conducted on the material and air pollution control devices are implemented during treatment. If LTTT were implemented for the high Btu tar it would require a medium capital investment relative to the other technologies screened.

On-site incineration. Incineration was chosen as an appropriate technology for the high Btu tar materials since it is a proven and reliable means of reducing levels of organic compounds. Incineration would effectively meet the RAO since the material would be placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact with the material. Treatment would lower the risk through a reduction in contaminant levels. Incineration would not be readily implementable due to local and governmental opposition of placing an incinerator at the facility. If incineration were implemented for the high Btu tar it would require a high capital investment relative to the other technologies screened.

Solidification. Solidification was not selected as an appropriate technology because its application to organic compounds is relatively innovative and its added effectiveness would be limited relative to consolidation in Impound 8. The 1995 solidification study (BB&L 1995) evaluated the extent to which organic contaminant leaching could be reduced by solidification via the addition of a Portland cement mixture. The study concluded that the use of solidification would not be effective at reducing the leachability of organics as measured by the TCLP test. If solidification were implementable for the high Btu tar it would require a medium capital investment relative to the other technologies screened.

Fuel blending/recycling. Fuel blending/recycling was not chosen as an appropriate technology as it is not readily implementable for the high Btu tar since outlets have not been identified. The high Btu tars remaining are not pumpable and would require specialized equipment and handling procedures to recycle the material into a usable fuel product. In addition, off-site transportation would require special equipment such as lined and heated tanker trucks is not readily available. If fuel blending/recycling were implementable for the high Btu tar it would require a high capital investment relative to the other technologies screened.

IPC. IPC was not chosen as an appropriate technology since it would not be readily implementable. This is due to the physical nature of the tars requiring extensive intricate construction materials and techniques to isolate the material from the environment. These techniques and materials are not readily available and do not have proven case studies upon which to base recommendations. If IPC were implementable for the high Btu tar it would require a high capital investment relative to the other technologies screened.

4.2.2. Category B: Low Btu tar/sludge (Impoundments 4, 5 (wet), 14, 20)

Consolidation in Impound 8. Consolidation in Impound 8 was chosen as an appropriate technology as it meets the RAO through placement in a secure, triple-lined waste management facility. It is readily implementable as long as appropriate air pollution control is provided during strength conditioning. If this alternative was implemented for the low Btu tar, it would require a medium capital investment relative to the other technologies screened.

Bioremediation. Bioremediation was chosen as an appropriate treatment technology for the low Btu tar/sludge since it would reduce organic constituents and is readily implementable. Bioremediation would meet the RAO since the material would be removed from the Impoundments and placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact. Treatment would reduce the risk through a reduction in contaminant levels. The results of the 1995 and 1996 bioremediation treatability testing, described in Section 3.4.2 and presented in Appendix B, concluded that bioremediation is a proven and reliable means of reducing organic constituents in the low Btu tar/sludge. The results of the 1995 and 1996 treatability testing also indicated that bioremediation would be readily implementable for the low

Btu tar/sludge if preconditioning were conducted on the material. If bioremediation were implemented for the low Btu tar/sludge it would require a medium capital investment relative to the other technologies screened.

LTTT. LTTT was chosen as an appropriate treatment technology for the low Btu tar/sludge since it would reduce organic constituents and is readily implementable. LTTT would meet the RAOs since the material would be removed from the impoundments, treated, and placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact. Treatment would lower the risk through a reduction in contaminant levels. The 1995 and 1996 LTTT treatability testing, described in Section 3.4.3 and presented in Appendix A, conducted on the high Btu tars located in Impoundments 1 and 2, concluded that LTTT is a proven means of reducing organic constituents. The low Btu tar/sludge material has similar types of organic compounds and material handling properties as the high Btu tar, therefore, it is likely that LTTT would also be an effective technology for treating the low Btu tar/sludge. LTTT would be readily implementable for the low Btu tar/sludge if preconditioning is completed and air pollution control devices are implemented during treatment. If LTTT were implemented for the low Btu tar/sludge it would require a medium capital investment relative to the other technologies screened.

On-site incineration. Incineration was chosen as an appropriate treatment technology for the low Btu tar/sludge since it is a proven and reliable means of reducing levels of organic compounds in the material. Incineration would effectively meet the RAO since the material would be placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact. Treatment would lower the risk through a reduction in contaminant levels. Incineration would not be readily implementable due to local and governmental opposition of placing an incinerator at the facility. If incineration were implemented for the low Btu tar/sludge it would require a high capital investment relative to the other technologies screened.

Solidification. Solidification was not selected as an appropriate technology because its application to organic compounds is relatively innovative and its added effectiveness would be limited relative to consolidation in Impound 8. The 1995 solidification study evaluated the extent to which organic contaminant leaching could be reduced by solidification via the addition of a Portland cement mixture. The study concluded that the use of solidification would not be effective at reducing the leachability as measured by the TCLP test. If solidification were implemented for the low Btu tar/sludge it would require a medium capital investment relative to the other technologies screened.

Fuel blending/recycling. Fuel blending/recycling was not chosen as an appropriate technology based on the results of the Impound 4/5 Fuel Blending/Recycling program, which concluded that the only remaining tars amenable to the fuel blending program were those located in Impoundments 4 and 14. Fuel blending/recycling is not readily implementable for this material since a recycling facility has not been identified. If a recycler is identified, a separate analysis on the viability of recycling the material in Impoundments 4 and 14 can be conducted. If fuel blending/recycling were implemented for the low Btu tar/sludge it would require a medium capital investment relative to the other technologies screened.

IPC. IPC was not chosen as an appropriate technology since it would not be readily implementable due to the physical nature of the tars requiring extensive intricate construction materials and techniques to isolate the material from the environment. These techniques and materials are not readily available and do not have proven case studies upon which to base recommendations. If IPC were implemented for the low Btu tar/sludge it would require a medium capital investment relative to the other technologies screened.

4.2.3. Category C: Impoundment 3

Consolidation in Impound 8. Consolidation in Impound 8 was chosen as an appropriate technology as it meets the RAO through placement in a secure, triple-lined waste management facility. It is readily implementable as long as appropriate air pollution control is provided during strength conditioning. If this alternative were implemented for the Impoundment 3 materials, it would require a medium capital investment relative to the other technologies screened.

Bioremediation. Bioremediation was not selected as an appropriate technology based on the results of the 1995/1996 bioremediation treatability study documented in Appendix B. The results of the treatability study indicated that while Impoundment 3 material exhibited a microbial population, removal of total VOCs and SVOCs was relatively low as compared to other Group III materials tested. If bioremediation were implementable for the Impoundment 3 materials it would require a medium capital investment relative to the other technologies screened.

LTTT. LTTT was chosen as an appropriate treatment technology for the Impoundment 3 material based on the results of the 1995 and 1996 LTTT treatability testing conducted on the high Btu tar. LTTT would meet the RAO since the material would be removed from the impoundment, treated, and placed in Impound 8 thereby eliminating the in migration of contaminants to ground water and eliminating public and environmental contact with the material. Treatment would lower the risk through a reduction in contaminant levels. The treatability testing, described in Section 3.4.3 and presented in Appendix A, concluded that LTTT is a proven means of reducing organic constituents. The Impoundment 3 material has similar levels of organic compounds and material handling properties as the high Btu tar, therefore, it is likely that LTTT would also be an effective means of treating the Impoundment 3 materials. LTTT would be readily implementable for the Impoundment 3 material if preconditioning is completed and air pollution control devices are implemented during treatment. If LTTT were implemented for the Impoundment 3 materials it would require a medium capital investment relative to the other technologies screened.

On-site incineration. Incineration was chosen as an appropriate treatment technology for the Impoundment 3 materials since it is a proven and reliable technology for reducing levels of organic compounds in the material. Incineration would effectively meet the RAO since the material would be removed from the impoundments and placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact. Treatment would lower the risk through a reduction in contaminant levels. Incineration would not be readily implementable due to local and governmental opposition of an incinerator at the facility. If incineration were implemented for the Impoundment 3 material it would require a high capital investment relative to the other technologies screened.

Solidification. Solidification was not selected as an appropriate technology because its application to organic compounds is relatively innovative and its added effectiveness would be limited relative to consolidation in Impound 8. The 1995 solidification study evaluated the extent to which organic contaminant leaching could be reduced by solidification via the addition of a Portland cement mixture. The study concluded that the use of solidification would not be effective at reducing leachability as measured by the TCLP test. If solidification were implementable for the Impoundment 3 material it would require a medium capital investment relative to the other technologies screened.

Fuel blending/recycling. Fuel blending/recycling was not chosen as an appropriate technology based on the results of the Impound 4/5 Fuel Blending/Recycling program which concluded that only remaining tars amenable to the fuel blending program were those located in Impoundments 4 and 14. However, fuel blending/recycling is not readily implementable for the Impoundment 3 material since the material is not easily pumpable and would require specialized material handling and separation equipment. In addition, the presence of large quantities of general plant debris within Impoundment 3 would make processing difficult. If a recycler is identified, a separate analysis of the viability of recycling the material in Impoundment 3 can be conducted. If fuel blending/recycling were implemented for the Impoundment 3 material it would require a high capital investment relative to the other technologies screened.

IPC. IPC was not chosen as an appropriate technology since it would not be effective or implementable due to the physical nature of the Impoundment 3 material requiring extensive intricate construction materials and techniques to isolate the material from the environment. These techniques and materials are not readily available and do not have proven case studies upon which to base recommendations. If IPC were implementable for the Impoundment 3 material it would require a high capital investment relative to the other technologies screened.

4.2.4. Category D: Non-hazardous material

Treatment technologies such as on-site thermal treatment, solidification, fuel blending/recycling, and IPC were not chosen as appropriate technologies since the Impoundment 5 (dry) and 26 material has not exhibited hazardous waste characteristics. The following technologies were evaluated for the assumed minor portion of non-hazardous material that exceeds treatment objectives and the assumed majority of non-hazardous material that will meet treatment objectives.

Consolidation in Impound 8. Consolidation in Impound 8 was chosen as an appropriate technology as it meets the RAO through placement in a secure, triple-lined waste management facility. It is readily implementable as long as appropriate air pollution control is provided during strength conditioning. if this alternative was implemented for the non-hazardous material, it would require a medium capital investment relative to other technologies screened.

Bioremediation. Bioremediation was chosen as an appropriate treatment technology for the non-hazardous material which exceeds treatment objectives since it would reduce organic constituents and is readily implementable. Bioremediation would meet the RAOs since the material would be removed from the impoundments and placed in Impound 8 thereby eliminating migration of contaminants to ground water and eliminating public and environmental contact. Treatment would reduce the risk through a reduction in contaminant levels. The results of the 1995 and 1996 bioremediation treatability testing, described in Section 3.4.2. and presented in Appendix B, concluded that bioremediation is a proven and reliable means of reducing organic constituents in the Impoundment 5 and 26 material. The results of the 1995 and 1996 treatability testing also indicated that bioremediation would be readily implementable for the non-hazardous material if preconditioning were conducted on the material. If bioremediation were implemented for the non-hazardous material it would require a medium capital investment relative to other technologies screened.

Off-site disposal. Off-site landfill disposal was chosen as an appropriate technology for the non-hazardous material since it would meet RAOs through placement in a secure waste management facility. Off-site disposal is readily implementable for limited volumes of material. If this alternative was implemented for the non-hazardous material, it would require a high capital investment relative to the other technologies screened.

4.2.5. Category E: General plant debris

Treatment technologies such as bioremediation, on-site thermal treatment, solidification, fuel blending/recycling, and IPC were not chosen as appropriate technologies for general plant debris due to implementability . Furthermore, debris would not be expected to exhibit hazardous waste characteristics and would therefore not require treatment prior to land disposal. As part of excavation activities associated with the Group III impoundments, general plant debris will be removed and placed into Impound 8, which, based on the size of the debris, has been designed to receive this type of material. The results of a debris placement evaluation presented in Appendix C indicate no size restrictions for placement of rocks and debris in Impound 8. Placement of debris should be no closer than 2-ft from any geotextile, geomembrane, or geosynthetic material, and debris should not be placed above the sideslopes.

4.3. Summary of applicable technologies

The aforementioned technologies have been screened with respect to the CERCLA screening criteria of effectiveness, implementability, and relative cost. The following matrix presents a summary of the potentially applicable technologies with respect to the Group III material categories. The technologies identified as potentially applicable will be applied to each material as set forth in the following chart.

Technology	Material Categories A	B	C	D	E
Consolidation into Impound 8	✓	✓	✓	✓	✓
Bioremediation		✓		✓	
LTTT	✓	✓	✓		
Incineration	✓	✓	✓		
Solidification					
Fuel Blending/Recycling					
IPC					
Off-site disposal				✓	

✓ = Potentially applicable technology with respect to material category.

Category A = High Btu tar
Category B = Low Btu tar/sludge
Category C = Impoundment 3 materials
Category D = Non-hazardous material
Category E = General plant debris

It should be noted that, although solidification was identified as not applicable for organics treatment and will not be carried through into the detailed analysis, it will be retained as secondary treatment for residuals. Solidification is a secondary treatment process to meet the strength requirement for placement in Impound 8 and to further reduce the leachability of metals.

5. Treatment objectives

5.1. Introduction

An integral component of each remedial alternative is the proposed final disposition of treated residuals in the Impound 8 facility. Impound 8 is a permitted, triple-lined waste management facility that has multiple leachate control and ground water control systems. The facility has been designed and constructed for disposal of impoundment sludges as part of a site-wide remedial program. As stated previously, this report assumes that the Impound 8 facility may be designated as a CAMU; otherwise incineration is the only appropriate technology. Direct placement within Impound 8 meets the RAO for the Group III impoundments. The USEPA and NJDEP have directed Cyanamid to conduct field-scale treatability studies to assist in identifying appropriate treatment objectives. Treatment prior to placement into the CAMU will provide an extra level of protection to the selected remedy. The information from the treatability studies has been considered along with the results of an evaluation of the principal threats in the Group III impoundment materials to determine appropriate treatment objectives. Consistent with the NCP, the evaluation of principal threats considers the toxicity, mobility, and volume of hazardous substances within the Group III impoundment materials. This approach reflects USEPA's emphasis on achieving protection of human health and the environment through the "aggressive but realistic use of treatment" (OSWER Directive 9355.0-27FS, April 1990).

To designate Impound 8 as a CAMU, the EPA Regional Administrator must determine that the CAMU designation will "minimize future releases, to the extent practical" (40 CFR Part 552(c)(4)), in order to ensure that "adequate long-term controls" are imposed for any wastes remaining within a CAMU (58 FR 8668). Finally, the Regional Administrator can use "as appropriate," treatment technologies "to enhance the long-term effectiveness of the remedial actions by reducing the toxicity, mobility or volume of material that will remain in place after closure of the CAMU" (40 CFR Part 264.552(c)(6)). Cyanamid will be achieving this effectiveness criteria for the Group III material through the following:

- Treatment of material exhibiting RCRA hazardous waste characteristics (thereby reducing toxicity, mobility and volume)

- Placement in Impound 8, a RCRA-permitted waste management facility (an adequate long-term control).

Achievable full-scale treatment objectives for organic constituents have been developed for the Group III impoundment materials based on the results of the pilot-scale treatability work conducted in late 1995 and early 1996. Additionally, an evaluation of reduction in the levels of the most hazardous constituents (highest risk) in the materials has also been used to support these objectives. The reduction of organic compound concentrations, demonstrated through the treatability studies, enhances the long-term effectiveness of the remedial action by reducing the toxicity, mobility, and volume of these compounds. Furthermore, placement of the treated sludges within Impound 8 provides adequate long-term control.

Treatment objectives for metal constituents will be non-leachable as measured by TCLP analysis. Compliance with this objective will be established during the remedial design phase and will consist of the use of pre- and post-treatment analytical data. Post-treatment will be conducted to achieve strength criteria, and if necessary, to meet TCLP levels prior to placement in Impound 8.

Group III materials that will not be subject to treatment include non-hazardous material such as fill material that does not exceed treatment objectives and general plant debris associated with the impoundments. The general plant debris consists primarily of concrete and steel. Debris will be removed from the impoundments and placed in the Impound 8 facility. While treatment is not necessary for a CAMU, Cyanamid will clean the debris as a best management practice consistent with EPA guidance. Cleaning methods will be evaluated and identified during the remedial design phase and may include mechanical separation, steam cleaning, pressure washing, or other method, as necessary, to remove free sludge prior to placement in Impound 8.

5.2. Supplemental pilot-scale treatability studies

Pilot-scale treatability studies were conducted for solid-phase bioremediation (Impoundments 3, 4, 5, 14, 20, and 26) and LTTT (Impoundments 1 and 2) during late 1995 and early 1996. These programs were conducted in accordance with NJDEP-approved Work Plans (O'Brien & Gere 1995b and O'Brien & Gere 1995a). This section briefly describes the programs and the results. A more complete description of the pilot-scale treatability studies is provided in Appendix A, *Impoundments 1 and 2 Pre-Design Testing Report,* and Appendix B, *Solid Phase Biotreatment Field Pilot Test Report.*

5.2.1. Compounds of concern

During excavation of the sludges from each of the Group III impoundments, sampling and analysis was conducted for VOCs, SVOCs and other characteristic parameters. Based on these results, a statistical analysis was performed to assess the prevalence of individual VOC and SVOC compounds within the Group III impoundment material. This analysis is provided in Appendix C. Based on this evaluation, eight compounds represented over 99.5% of the mass of detected VOC and SVOC compounds. These were identified as predominant compounds of concern, and are as follows:

VOC
- Benzene
- Toluene
- Total Xylenes

SVOC
- Naphthalene
- Nitrobenzene
- 1,2 Dichlorobenzene
- N-nitrosodiphenylamine
- 2-methylnaphthalene

In addition to considering prevalence within the Group III impoundments, the compounds of concern are justified based on the evaluation of toxicity, mobility and volume. This evaluation, presented in Section 5.6, demonstrates that four compounds, i.e., benzene, nitrobenzene, naphthalene, and n-nitrosodiphenylamine represent more than 90 percent of the cancer and noncancer risks associated with the Group III impoundment materials. For these reasons, the selected compounds of concern are appropriate as indicator compounds for assessing treatment objectives during full-scale remediation.

Additionally, as discussed in Section 5.1, treatment objectives for metals will be RCRA-defined leachate concentration levels as measured by TCLP analyses. Compliance with this objective will consist of the use of pre or post-treatment analytical data.

5.2.2. Bioremediation field pilot testing

The bioremediation field pilot testing program was conducted on materials excavated from Impoundments 3, 4, 5, 14, 20, and 26. Solid-phase bioremediation was previously identified by Cyanamid and acknowledged by NJDEP as being more implementable and cost-effective than other forms of treatment for these impoundments. Based on this, the NJDEP directed Cyanamid to conduct field pilot testing for solid-phase bioremediation for the purpose of establishing treatment objectives. Appendix B presents results of the field pilot testing.

The pilot process generally consisted of excavation, pre-conditioning, and biotreatment. Material was excavated from each of the subject impoundments and blended with additives based on ratios developed during laboratory testing. Additives included sawdust, lime, and nutrient addition.

Following blending, the amended material (compost) was aerated to promote biological treatment. The pilot test was operated for three consecutive three week stages, followed by a three week confirmation test. During this time, moisture and nutrients were added to the composted material. In order to maintain adequate temperature for biological treatment, the pilot program was conducted inside a temporary heated structure that was specially constructed for the test. Analytical sampling was conducted after weeks 3, 6, and 9 to assess the progress of the biological treatment for each treatment phase.

The analytical results of the testing are summarized in Appendix D. These results compare the reduction of VOCs and SVOCs with respect to raw material concentrations. Solid-phase bioremediation was generally able to reduce the concentration of most VOCs and SVOCs by greater than 90% based on the original excavated sludge concentrations. An exception to this removal effectiveness was the treatment of material within Impoundment 3 where removal values were significantly less than other materials. Due to the apparent inhibitory nature of the Impoundment 3 material, bioremediation was determined not to be an appropriate technology for this impoundment. For the other impoundments that underwent bioremediation testing, benzene removal was particularly effective, averaging 99% after three weeks of treatment.

Within Appendix D, the reduction in concentrations was statistically analyzed through the progression of the treatment. This analysis revealed that the level of treatment at three weeks was within approximately one standard deviation of the time-averaged treatment level (weeks 3, 6, and 9) for the prevalent compounds that were identified.

The following table summarizes the treatment concentrations of representative compounds of concern. This process focuses the evaluation of treatment to what could be reasonably applied across the entire mass of the Group III impoundment material. By using this approach, appropriate and achievable compound reductions are identified which can be utilized in determining full-scale treatment objectives.

Compound Compounds of Concern	Initial Conc. (mg/kg)	Minimum Treatment Level I-4	I-5	I-14	I-20	I-26	Max. of Minimum	Overall Average[1]	Overall Std. Dev.[1]
Benzene	21,000	1.20	1.09	1.78	0.610	0.001	1.78	2.49	2.98
Toluene	3,100	0.759	2.84	2.80	0.187	0.008	2.84	4.94	7.89
Xylene (total)	5,500	1.18	3.63	2.00	50.900	0.007	50.9	30.5	52.0
Naphthalene	240,000	250	3360	2850	9.17	9.59	3360	3490	5024
Nitrobenzene	8,500	3.80	71.8	1850	4.30	4.47	1850	517	981
1,2-Dichlorobenzene	1,700	77.7	20.4	4.37	1.37	11.7	77.7	48.5	70.0
N-Nitrodiphenylamine	21,000	14.8	967.00	6390	17.6	6.61	6390	1878	3340
2-Methylnaphthalene	9,200	61.0	591.00	309	3.80	3.42	591.00	299	377

Note: (1) Refer to Appendix F for basis of calculation.

Based on this data and the statistical analysis, a biological treatment time frame of three to nine weeks and the associated minimum treatment levels have been identified as being appropriate for determining achievable treatment objectives for the Group III impoundment materials. These levels sufficiently enhance the protectiveness of the remedial alternatives which, with final placement into Impound 8, already meet the remedial action objective. Additional treatment beyond this timeframe does not provide sufficient additional concentration or risk reduction, as demonstrated through the statistical analysis, to justify its use. The benefits potentially derived from further enhancements beyond that associated with the pilot study treatment timeframe is substantially less than the additional costs of the unwarranted treatment. For this reason, the minimum concentration data sets associated with the three to nine week biological treatment timeframes will be utilized in developing the achievable treatment objectives.

5.2.3. Low temperature thermal treatment

LTTT was identified as being a potential remedial technology for Impoundments 1 and 2. For this reason, Cyanamid conducted various treatability studies using the LTTT technology. The initial treatability studies used TCLP standards as a benchmark. NJDEP advised Cyanamid that TCLP standards were not relevant. Instead, NJDEP required that Cyanamid conduct further LTTT studies to assess performance treatment levels. Appendix A presents the results of these studies.

A major focus of the low temperature pilot program was to develop a comparable database of achievable LTTT levels by providing a consistent raw material for testing different LTTT operating parameters. The program consisted of excavation, pilot-scale preconditioning, and vendor testing. The LTTT technologies utilized during this program included pre-conditioning and aerobic and anaerobic treatment technologies.

Materials obtained from Impoundments 1 and 2 were pre-conditioned to detackify and adjust pH through mixing with different additives (Phase I conditioning). An aggregate additive (Phase II conditioning) was also used by certain LTTT technologies which had process limitations on maximum Btu content and percent sulfur.

The pretreatment results indicated that Portland cement achieved the best Phase I conditions for material handling. Analysis of the data revealed the original VOC/SVOC concentrations of the raw sludge were significantly reduced as a result of this preconditioning. Phase I samples were also sent for low temperature thermal treatment testing using an anaerobic thermal screw treatment technology. Operating conditions for each material tested was based on an approximate temperature range of 200°F to 600°F that was achieved through successive passes of approximately 10 min retention time each.

Phase II preconditioning consisted of mixing limestone with the Phase I product. Phase II material was also sampled for chemical and physical parameters. Further VOC/SVOC removal was realized as a result of Phase II conditioning. Phase II samples were sent to other LTTT vendors. The first technology was an aerobic treatment technology capable of testing process conditions at 300°F and 500°F for retention times of 15 and 25 min. The second technology tested was an anaerobic technology which evaluated operating conditions at 600°F and 800°F. In the vendor's full-scale system, the material undergoes a low temperature processing at one of the above temperatures, and then is further processed whereby organic constituents undergo pyrolysis to form coke which is then used as a supplemental fuel source for the system. This system borders on incineration as the impoundment material which is used to form coke is ultimately combusted.

The analytical results of the testing are provided in Appendix E and summarized in the following table. Within Appendix E, the reduction in concentrations for the LTTT was statistically analyzed based on the different minimum concentrations achieved through the operating parameters tested. These results compare the reduction of VOCs and SVOCs with respect to the maximum untreated concentrations of select detected compounds.

Compounds of Concern	Max. Initial Conc. (mg/kg)	Min 2VR-1	Min 2MIX-1	Min 2HC-1	Min 1MIX-1	Max of Min	Overall Avg.(1)	Overall Std Dev(1)
Benzene	61,000	0.0068	0.17	0.243	0.118	0.243	2.67	5.15
Toluene	16,200	0.0065	0.424	0..323	0.0408	0.424	7.88	19.9
Xylenes (total)	3,440	0.001	0.0855	0.219	0.0167	0.219	5.18	6.98
Naphthalene	9,860	0.053	1.50	0.885	0.448	1.5	159	204
Nitrobenzene	1,330	0.05	1.30	1.4	1.20	1.40	5.20	9.39
1,2-Dichlorobenzene	2,210	0.05	0.793	1.06	1.40	1.40	19.70	18.1
N-Nitrosodiphenylamine	<5.5	0.023	0.61	0.65	0.57	0.65	0.608	0.141
2-Methylnaphthalene	1,520	0.043	0.617	0.424	0.535	0.617	19.2	22.8

Note: (1) Refer to Appendix F for basis of calculation.

Based on this data and the statistical analysis, a range of LTTT operating conditions has been selected as the performance basis for evaluating this technology for the Group III impoundment material. This range included temperatures of 300°F - 800°F and retention times of 10 - 25 minutes. Within the pilot study, certain data were obtained from processes that were outside of the LTTT operating range considered appropriate for this material. These processes, which were not included in the evaluation, included Soil tech's ATP system (which approximates incineration) and certain Weston operating conditions which were below 300°F. Outside the operating range does not increase the enhancement of the remedial alternatives' ability to meet the RAO proportional to the associated additional costs. Therefore, it is consistent with CMS/FS guidance to exclude these operating conditions in evaluating LTTT alternatives.

5.3. Treatability scale-up factors

As discussed in Section 5.2, both the bioremediation and LTTT can significantly reduce constituent concentrations associated with Group III materials prior to their placement into Impound 8. Treatment and associated compound reduction enhances the protectiveness of the remedial alternatives. The removal efficiency, and the ability to analytically demonstrate the consistency of that removal, is dependent on several variables including:

- the consistency of material

- the ability of the analytical method to accurately depict the constituent concentrations

- the representative sampling of the treated materials.

In evaluating a treatment objective which could be consistently achieved and committed to during full scale treatment, pilot studies were conducted and samples of treated material were analyzed. The results of the pilot studies formed the basis for the determination of consistently achievable treatment objectives. For the Group III material, a treatment objective must be established which is consistently achievable and demonstrated through compliance sampling once full scale treatment is implemented. To generate this treatment objective, the pilot-scale analytical results which represent achievable levels for the Group III impoundment materials, must be adjusted to account for scale-up. This adjustment is derived from incorporating the variabilities described above in establishing achievable treatment objectives. This approach in adjusting pilot scale results to develop treatment objectives is consistent with design of a full scale system which will require compliance monitoring.

In the development of full-scale treatment objectives, it is critical to identify the achievable analytical levels determined during the pilot scale treatability studies. Achievable is defined as the highest treatment level from the data set which contained the lowest values (minimum data set) obtained from each technology. For biotreatment, the minimum treatment levels were selected for each impoundment (4, 5, 14, 20 and 26) based on treatability data from weeks 3, 6, and 9. This comprises the minimum data set, from which the maximum data point was selected as achievable. Similarly, the minimum data set for LTTT was obtained from evaluating the treatability results from the various Impoundment 1 and 2 layers tested. Since biotreatment was deemed not effective for Impoundment 3, LTTT has been identified as appropriate, based on similar characteristics to Impoundments 1 and 2. This approach best characterizes treatment of the most difficult material within Group III. These levels would then be used to represent all of the material requiring treatment based on the technology tested. Therefore, for the Group III impoundment material, the achievable levels from the bioremediation and LTTT pilot studies, as described above, will be utilized in developing full-scale treatment objectives. Appendix F provides the calculation basis for this analysis.

The distribution of sampling results among impoundment samples provides an indication of the variability within a small number of pilot test treatment results. The pilot test samples do not, however, account for potential variability in heterogeneity of materials within an impoundment and variation in sample collection methods. As such, they do not provide a confidence limit value which can be readily applied to the final treatment system. Modifying factors must be used to adjust the pilot treatment results to that which can consistently be achieved for a full scale system. These factors will account for the three phases of variability listed above. The following sections describe the adjustment process utilized for each variable.

Consistency of material. The variability between pilot test treatment samples can be viewed as the standard deviation of the results (concentration value). Typically, three standard deviations away from the overall mean value incorporates variability inherent in approximately 99% of the sample analyses. However, if viewed relative to the overall mean, it is anticipated that the compliance limit would still be exceeded, statistically, by a percentage of the samples. This is not acceptable in establishing compliance levels for a full-scale system. Alternatively, if three standard deviations are applied to the achievable pilot test samples (maximum of minimum data set values), the resulting shift in the confidence incorporates potential future values which may exceed those levels. It is therefore appropriate to use the achievable pilot test result plus a confidence limit (three standard deviations) in establishing the maximum full scale treatment objectives.

Analytical method variability. Analytical and instrumental variation may also skew the reported results. Both of these factors are routinely evaluated in the laboratory through the addition of external standards or surrogates to the samples. Typically, analytical responses of 10% to 30% over the actual result can be observed and are accepted by regulatory agencies. This is standard within approved analytical methodologies such as SW846 and CLP.SOW OLM01.0. The lower limit of 10% was used for scale-up to establish the treatment objective for the full scale treatment system.

Representative sampling. Sample collection of heterogenous materials, such as those present within the Group III Impoundments, also provides a recognized variability in meeting established limits. The NJDEP, in particular, has adopted the use of compliance criteria for environmental remediations requiring sampling (Site Remediation News, Spring 1995, Volume 7, Number 2). Compliance averaging is a method of determining the acceptability of sampling results compared to a target criteria. This is accomplished by using a "maximum available concentration" in determining compliance. This method prevents indicating non-compliance based on a result which may not be representative of a prevailing condition. Therefore, in developing treatment objectives for a full-scale system based on pilot scale analytical results, utilization of this method to account for sampling variability is warranted. The NJDEP has accepted the use of five times the analytical result, with a ceiling of 200 ppm, as appropriate to develop a compliance criteria.

Application of these three adjustment factors to minimize variability provides a reasonable full-scale treatment objective. The following table presents the achievable pilot scale levels and the resultant treatment scale up values. These are determined by first adding three standard deviations to account for the inconsistency of the material during treatment, the resultant level is then adjusted by an additional 10% to account for analytical variability (and rounded for clarity), and finally multiplied by 5 and/or compared to the ceiling of 200 ppm to account for sampling variability. In this case, only the benzene results were multiplied by 5, all others met the NJDEP ceiling of 200 ppm.

Biotreatment (applicable to Impoundments 4, 5, 14, 20 and 26)

Compound	Treatment Result	Overall Standard Deviation	Adjusted for 3 Std. Dev.	Adjusted for Analytical Variance	Maximum Treatment Objectives
Benzene	1.78	2.98	10.7	12	60
Toluene	2.84	7.89	26.5	29	145
Xylenes	50.9	52.0	20.7	230	230
Naphthalene	3360	5024	18432	20300	13100*
Nitrobenzene	1850	981	4792	5300	5200*
1,2 Dichlorobenzene	77.7	70.0	288	320	320
N-Nitrosodiphenylamene	6390	3340	16409	18100	14300*
2-methylnaphthalene	591	377	1721	1900	1900

Note: Analytical values in mg/kg.
* The maximum treatment objectives for these compounds were retained from the original April 1996 CMS.

LTTT (Applicable to Impoundments 1, 2 and 3)

Compound	Treatment Result(1)	Overall Standard Deviation	Adjusted for 3 Std. Dev.	Adjusted for Analytical Variance	Maximum Treatment Objectives
Benzene	0.24	5.15	15.7	17	85
Toluene	0.42	19.9	60.0	66	200
Xylenes	0.22	6.98	21.2	23	115
Naphthalene	150	204	613	670	670
Nitrobenzene	1.40	9.39	29.6	33	165

LTTT (Applicable to Impoundments 1, 2 and 3)

Compound	Treatment Result(1)	Overall Standard Deviation	Adjusted for 3 Std. Dev.	Adjusted for Analytical Variance	Maximum Treatment Objectives
1,2 Dichlorobenzene	1.40	18.1	55.8	61	200
N-Nitrosodiphenylamene	0.65	0.14	1.07	1	5
2-methylnaphthalene	0.62	22.8	68.9	76	200

Note: Analytical values in mg/kg.
* (1) Data based on Impoundments 1 and 2

5.4. UTS and UTS variance comparison

The NJDEP requested that the results of the treatability studies be compared to Universal Treatment Standards (UTS) or UTS treatability variance guidance (EPA Superfund LDR Guide 6A). Appendix G presents the results of the LTTT and biotreatment treatability programs with respect to the UTS standard and the variance guidance. The comparison was developed based on the directions provided within EPA Superfund LDR Guide 6A. This procedure included the following:

- Identify RCRA waste codes for materials present in the Group III impoundments
- Identify Best Demonstrated Available Technology (BDAT) constituents
- Include constituents listed in March 1993 Baseline Endangerment Assessment
- Divide BDAT constituents into structural/functional groups
- Compare untreated constituent concentration with threshold concentrations and select appropriate concentration level or percent reduction range.
- A comparison of the achievable treatment objectives for the entire mass of Group III material, based of the field pilot studies, shows that the UTS or UTS variance levels cannot be consistently achieved. Compliance with those levels can only be achieved through incineration. Therefore, as guided by the regulatory agencies, the results of the treatability studies and an evaluation of the principal risks that the Group III impoundment materials pose, were

utilized to determine appropriate, consistently achievable treatment objectives.

The USEPA and NJDEP also requested an evaluation of the biotreatment levels relative to removal efficiencies. This was accomplished by summarizing the structural/functional groups to obtain each group's overall removal efficiency. The summary of the results is provided below. The complete analysis is provided in Appendix G.

Biotreatment structural/functional grouping analysis (Impoundments 4, 5, 14, 20 and 26)

Structural/ Functional Group	Feed Treatability Data (mg/kg)	6A Variance Percent Reduction Rate	Treatment Level (1) (mg/kg)	Percent Reduction
Non-polar Aromatics	21,000	90 - 100	54	99.7%
Halogenated Non-polar Aromatics	4,860	90 - 99.9	1,570	67.7%
Halogenated Phenols	18,200	90-99	1,315	92.8%
Halogenated Aliphatics	21,840	95-99.9	394	98.2%
Halogenated Cyclics	9.200	90 - 99.9	905	90.2%
Nitrated Aromatics	41,300	99.9 - 99.99	4,630	88.8%
Polynuclear Aromatics	266,270	95 - 99	17,315	93.5%
Other Polar Organics	57,350	90 - 99	14,040	75.5%

Note:
(1) Derived from the average treatment cbjectives, as defined in Section 5.6 and Appendix F.

As can be seen from the above, biotreatment achieves percent reductions that are within the acceptable 6A ranges for four of the eight structural/functional groups. Greater than 90% removal is realized for five structural/functional groups. When the mass of material categorized in these groups is summed, it represents over 95% of the regulated compounds in the waste material. Of those four structural/functional groups which do not meet the 6A ranges, one of the percent reductions is over 90% and the remainder are over 75% of their target values. This further supports biotreatment as the appropriate treatment technology for this material, given its treatment effectiveness for the regulated compounds.

5.5. Relative risk analysis

An evaluation of the toxicity, mobility, and volume of specific constituents in the material was performed to identify the constituents of primary concern. This analysis is presented in Exhibit H. Within this analysis, the most prevalent compounds of concern are ranked according to total volume in the Group III impoundments, the toxicity of the constituents considering both cancer and noncancer effects, and the mobility of the constituents in the environment. These parameters were selected consistent with USEPA's preference for reduction of toxicity, mobility, or volume through treatment, as expressed in the NCP.

The approach taken to rank the chemicals of potential concern in the Group III impoundments is discussed in detail in Exhibit H. First, the volume of each constituent was represented by multiplying the quantity of material in each impoundment by the maximum concentration in each impoundment, as indicated by the results of the material characterization performed in conjunction with the pilot scale treatability studies. The toxicity of each constituent was represented using USEPA published oral slope factor (SF) values for carcinogenic effects and chronic oral reference dose (RFD) values for noncancer effects. To allow for the ranking to take into account both cancer and noncancer effects, the toxicity criteria were normalized to correspond to a 1×10^{-6} cancer risk, or a hazard quotient (HQ) of 1.0. As a measure of mobility, the ranking also considers the soil-to-water partitioning coefficient (K_d). The K_d value represents a measure of the mobility of each compound through the ground water migration pathway. In this way, volume, toxicity, and mobility are explicitly combined in the ranking. Furthermore, volume, toxicity, and mobility parameters are combined in a manner such that the ultimate rankings provide a measure of the relative hazard of each constituent in the Group III impoundment materials.

As indicated by the ranking presented in Exhibit H, the inherent risks posed by the Group III impoundment materials are associated primarily with a limited number of constituents, particularly benzene and nitrobenzene. Specifically, it was calculated that benzene and nitrobenzene represent more than 90 percent of the cancer and noncancer hazards associated with the Group III impoundment materials. Benzene is a known human carcinogen; noncancer effects are also associated with benzene and nitrobenzene.

The analysis concludes that with a 99% reduction in the benzene mass alone, the reduction in overall relative risk related to the Group III impoundment material approaches 99%. As presented in the previous sections, the scale-up values represent a 99% removal of benzene. Additionally, the treatability studies showed reductions of other compounds which would increase the overall reduction in relative risk to over 99%.

5.6. Treatment objectives

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It is believed that scale-up values for the compounds of concern identified in Section 5.3 can consistently be achieved for the Group III impoundments. Furthermore, these levels represent a relative risk reduction of over 99%. Additionally, with the corresponding anticipated reductions in other impoundment constituents, the risk reduction will be approximately 99%, based on the evaluation of toxicity, mobility and volume presented in Exhibit H.

Treatment objectives have been developed for biotreatment and LTTT, consistent with the treatability test results and appropriate scale-up factors. Compliance monitoring is intended to monitor the residual levels of the compounds of concern for Group III materials as they are placed in Impound 8. For this reason, both maximum and average treatment objectives have been established for compliance monitoring purposes. Maximum treatment objectives represent the highest concentration which could be disposed in Impound 8, and an average treatment objective represents the average concentrations over the monitoring period. Maximum treatment objectives were calculated using the maximum of the minimum values as described in Section 5.3.

For the low temperature thermal treatment average treatment objectives, the lesser of the maximum treatment objective or the 6A Variance level was utilized except for nitrobenzene where the pilot testing showed the 6A Variance level could not be met.

For the bioremediation average treatment objectives the lower of the maximum treatment objectives or the weighted average treatment objective was used. The exception was naphthalene which used the 6A Variance level. The weighted average objectives were calculated by using the minimum pilot treatment level from each impoundment and applying a weighting factor based on volume of material within the impoundment. The following weighting factors were used:

Impoundment	Volume (yd^3)	Weighting Factor
4	900	0.007
5	104.800	0.78
14	4,000	0.030
20	7,800	0.058
26	17,600	0.13
TOTAL	135,100	1.00

Based on the heterogeneity of the material, the monitoring period for average compliance is proposed as six months. The frequency of monitoring for maximum treatment objectives will be established during the remedial design phase of this program. However, it should be noted that the maximum treatment objectives represent the maximum values obtained during any sampling day (i.e., a daily maximum). Sampling will be performed during initial raw material characterization, after treatment and prior to final placement in Impoundment 8.

The proposed treatment objectives, as defined above, are as follows:

Biotreatment (Impoundments 4, 5, 14, 20 and 26)

Compound of Concern	Average Treatment Objective (mg/kg)	Maximum Treatment Objective (mg/kg)
Benzene	54	60
Toluene	145	145
Xylene	180	230
Naphthalene	12,000	13,100
Nitrobenzene	3,360	5,200
1,2-dichlorobenzene	250	320
N-nitrosodiphenylamine	12,000	14.300
2-methylnaphthalene	1,760	1,900

LTTT (Impoundments 1, 2, and 3)

Compound of Concern	Average Treatment Objective (mg/kg)	Maximum Treatment Objective (mg/kg)
Benzene	85	85
Toluene	200	200
Xylene	115	115
Naphthalene	550	670
Nitrobenzene	165	165
1,2-dichlorobenzene	200	200
N-nitrosodiphenylamine	5	5
2-methylnaphthalene	76	200

For metals, both average and maximum compliance values will be RCRA leachate concentration levels based on the TCLP analysis.

Based on the treatment objective evaluations, USEPA and NJDEP requested an overall mass evaluation for the eight COCs as well as the regulated compounds (VOC and SVOC) for biotreatment. Appendix H presents these evaluations.

6. Development of alternatives

Based on the results of the technology evaluation discussed in Section 4, remedial technologies for each Group III Impoundment material category were assembled into remedial alternatives that address the RAOs. In accordance with the NCP, a no action alternative, which includes only institutional actions, was identified for each material category to provide a baseline for alternative comparison. Descriptions of the remedial alternatives which were developed for each material category are presented in this section, and detailed evaluation of these remedial alternatives is presented in Section 8.

6.1. Category A: High Btu tar

Four remedial alternatives were developed for the high Btu tar material, which consist of Impoundment 1 and 2 materials. The four remedial alternatives identified 1) include no action/institutional actions, 2) consolidation into Impound 8, 3) LTTT, and 4) on-site incineration. A treatment train for the high Btu tar, consisting of pretreatment, treatment, and post-conditioning, was developed for the LTTT and on-site incineration alternatives. Material will undergo treatment until the Group III treatment objectives are achieved. Based on heterogeneity, some materials would meet the treatment objectives prior to implementation of more active components of the treatment technologies. Once the treatment objectives are met, the material will be placed in Impound 8.

6.1.1. Alternative A1 - no action/institutional actions

Alternative A1, no action/institutional actions, as required by the NCP, provides a baseline for comparison to the other alternatives. Alternative A1 consists of access restrictions, monitoring, and continued odor control. Access restrictions would include installation of fencing to enhance existing fencing at Impoundments 1 and 2, as well as future land use restrictions due to Impoundment 1 and 2 materials remaining in place. Ground water monitoring would be performed as part of Alternative A1 to track the impact to site ground water from the Impoundment 1 and 2 materials. Finally, the existing water cover/liner over Impoundments 1 and 2 would be maintained to minimize VOC emissions and resulting odors.

6.1.2. Alternative A2 - consolidation in Impound 8

Alternative A2 involves excavation of Impoundments 1 and 2 material and placement of the material into the Impound 8 facility. A conceptual treatment train diagram for the consolidation in Impound 8 alternative is presented as Figure 6-1.

Material handling. Impoundment 1 and 2 material would be removed from the impoundments using standard excavation techniques, such as a clamshell and crane. The impoundment contents would be removed, and underlying soil would be excavated to the top of ground water. Engineering controls, such as a water, foam, or membrane cover, may be utilized during excavation to minimize VOC emissions and associated odors. Excavated materials may be placed in a temporary staging area. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Conditioning. Excavated material would be conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility and, as needed, to meet RCRA TCLP limits for metals. Conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture. Conditioning would include off-gas control such as condensation, carbon adsorption, or thermal oxidation. Gas scrubbing and particulate control may also be necessary for inorganic acid gases and particulates that may be evolved during processing.

Final placement. Prior to placement into Impound 8, Impoundment 1 and 2 materials would be sampled and analyzed to confirm achievement of unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of evaluation sampling and analysis would be identified during remedial design. Material exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. The Impoundment 1 and 2 excavations would be backfilled with the earthen berms and possibly clean fill to above the ground water level. Natural re-vegetation would be allowed to occur.

Completion of remedial activities associated with Alternative A2 would be within approximately 1 to 2 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.1.3. Alternative A3 - LTTT

Alternative A3, LTTT, involves treatment of the material using LTTT to achieve Group III treatment objectives, and placement of the treated material in the Impound 8 facility. A conceptual treatment train diagram for the LTTT alternative is presented as Figure 6-2.

Material handling. Impoundment 1 and 2 material would be removed from the impoundments using standard excavation techniques, such as a clamshell and crane. Impoundment contents would be removed, and underlying soil would be excavated to the top of ground water. Engineering controls, such as a water, foam, or membrane cover, may be utilized during excavation to minimize VOC emissions and associated odors. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Excavated material would be pre-treated as necessary to condition the material prior to processing in the LTTT component. As described in Section 3.4.6., pretreatment would consist of TEMD, which would accomplish detackification, neutralization, and reduction of organic constituents using mixing equipment, controlled volatilization, and thermal desorption. Impoundment 1 and 2 materials would be mixed with portland cement and aggregate in mixing equipment, such as a pugmill, to detackify and neutralize the materials for subsequent materials handling and treatment. The mixing process would generate heat through hydration (approximately 100 to 150°F), which would assist in VOC and SVOC removal during mixing. The pretreatment step would also include off-gas control, such as condensation, carbon adsorption, or thermal oxidation. Gas scrubbing and particulate control may also be necessary for inorganic acid gases and particulates that may be evolved during processing.

The pretreated material will then be treated via LTTT. Based on treatability testing, the LTTT system will operate at a material processing temperature of approximately 300°F at a residence time of approximately 15 min. These operating parameters were demonstrated to remove VOCs and SVOCs to the Group III treatment objectives. Either aerobic or anaerobic LTTT processing was demonstrated as meeting the Group III treatment objectives during the treatability testing at these operating parameters. Actual full-scale operating parameters may be modified depending on the nature of the pre-treated material and extent of organic removal necessary to achieve the treatment objectives. Similar to pretreatment, the vapors generated during LTTT would be collected and treated by a vapor treatment train which may use one or more of the following technologies: dust collection, acid gas scrubbing, condensation, adsorption or thermal oxidation.

Treated Impoundment 1 and 2 materials would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility. Post-conditioning would also be performed to meet TCLP limits for metals, as needed. Post-conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture.

Final placement. Treated Impoundment 1 and 2 materials would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements, and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. The Impoundment 1 and 2 excavations would be backfilled with the earthen berms and possibly clean fill to above the ground water level. Natural re-vegetation would be allowed to occur.

Completion of remedial activities associated with Alternative A3 would be within approximately 2 to 5 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases..

6.1.4. Alternative A4 - on-site incineration

Alternative A4, on-site incineration, involves treatment of the material on-site using incineration to achieve Group III treatment objectives, and placement of the treatment residuals in the Impound 8 facility. A conceptual treatment train diagram for the on-site incineration alternative is presented as Figure 6-3.

Material handling. Impoundment 1 and 2 material would be removed from the impoundments using standard excavation techniques, such as a clamshell and crane. Impoundment contents would be removed, and soil would be excavated to the top of ground water. Engineering controls, such as a water, foam, or membrane cover, would be utilized during excavation to minimize VOC emissions and associated odors. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Excavated material would be pre-treated as necessary to condition the material prior to processing in an on-site incineration unit. If pretreatment is necessary, material addition would be implemented in mixing equipment, such as a pugmill. Pretreatment would include off-gas control, such as condensation, carbon adsorption, or thermal oxidation. Particulate control may also be necessary for dust that may be evolved during processing.

Impoundment 1 and 2 material would be processed through an incineration unit on-site to remove VOCs and SVOCs to achieve the Group III treatment objectives. The on-site mobile incinerator will be strategically placed at the site to minimize on-site material handling. The vapors generated during incineration would be collected and treated by a vapor treatment train which may use one or more of the following technologies: dust collection, acid gas scrubbing, condensation, adsorption or thermal oxidation.

Residual ash would be post-conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility and, as needed, to meet TCLP limits for metals. Post-conditioning, for the purpose of strength conditioning, would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture.

Final placement. Residual ash would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements, and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8, the on-site permitted, hazardous waste management facility.

Site restoration. The Impoundment 1 and 2 excavations would be backfilled with the earthen berms and possibly clean fill to above the ground water level. Natural re-vegetation would be allowed to occur.

Completion of remedial activities associated with Alternative A4 would be within approximately 2 to 5 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.2. Category B: Low Btu tar/sludge

Five remedial alternatives were developed for the low Btu tar/sludge material. The five remedial alternatives developed include 1) no action/institutional actions, 2) consolidation in Impound 8, 3) biological treatment, 4) LTTT, and 5) on-site incineration. These alternatives are summarized in Section 4. A treatment train for the low Btu tar/sludge, consisting of pretreatment, treatment, and post-conditioning, was developed for the biological treatment, LTTT and on-site incineration alternatives. Material will be treated through the components of the treatment train until the treatment objectives are achieved. Based on the heterogeneity, some materials would meet the treatment objectives prior to implementation of more active components of the treatment technologies. Once the treatment objectives are met, the material will be placed in Impound 8.

6.2.1. Alternative B1 - no action/institutional actions

Alternative B1, no action/institutional actions, required by the NCP, provides a baseline for comparison to the other alternatives. Alternative B1 consists of access restrictions and monitoring. Access restrictions would include maintenance of the existing site controls which restrict access to Impoundments 4, 5, 14, and 20, as well as future land use restrictions due to the low Btu value tar/sludge materials remaining in place. Ground water monitoring would be performed as part of Alternative B1 to track the impact to site ground water from the low Btu value tar/sludge material. Finally, the existing water cover over Impoundments 4, 5 (wet portion), and 14 would be maintained to minimize VOC emissions and resulting odors.

6.2.2. Alternative B2 - consolidation in Impound 8

Alternative B2 involves excavation of the Impoundment 4, 5 wet, 14, and 20 material and placement of the material into the Impound 8 facility. A conceptual treatment train diagram for the consolidation in Impound 8 alternative is presented as Figure 6-1.

Material handling. Low Btu value tar/sludge material would be removed from the impoundments using standard excavation techniques, such as a long-reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the low Btu value materials in Impoundments 4, 5, and 14, as described in Section 6.5.2. Engineering controls, such as a water, foam, or membrane cover, may be utilized as necessary during excavation to minimize VOC emissions and associated odors. Excavated material may be placed in a temporary staging area. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Conditioning. Excavated material would be conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility and, as needed, to meet TCLP limits for metals. Conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture. Conditioning would include off-gas control such as condensation, carbon adsorption, or thermal oxidation. Particulate control may also be necessary for particulates that may be evolved during processing.

Final placement. Prior to placement into Impound 8, low Btu tars/sludges would be sampled and analyzed to confirm achievement of unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of evaluation sampling and analysis would be identified during remedial design. Material exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8, the on-site permitted, waste management facility.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundments. The impoundments will be controlled by maintenance of the berms.

Completion of remediation activities associated with Alternative B2 would be within approximately 1 to 2 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.2.3. Alternative B3 - bioremediation

Alternative B3, solid-phase bioremediation involves treatment of the material using solid-phase bioremediation to achieve Group III treatment objectives, and placement of the treated materials in the Impound 8 facility. A conceptual treatment train diagram for the solid-phase bioremediation alternative is presented as Figure 6-4.

Material handling. Low Btu value tar/sludge material would be removed from the impoundments using standard excavation techniques, such as a long-reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the low Btu value materials in Impoundments 4, 5, and 14, as described in Section 6.5.2. Engineering controls, such as a water, foam, or membrane cover, would be utilized as necessary during excavation to minimize VOC emissions and associated odors.

Excavated material will be conditioned by blending with a material such as sawdust to improve porosity and handling ability (detackify). Amendments such as nutrients (based on the carbon:nitrogen:phosphorous ratio) and lime (for pH adjustment) would be added during this phase of operation. Engineering controls for odor may include a vapor collection hood over the mixing unit or an air vent at the collar of the ribbon blender. Collected air would be treated prior to discharge with carbon adsorption or oxidation. Blended material may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Biological processing using modified compost or aerated pile techniques would be used for treatment. Compost process alternatives include:

- forced air assisted windrow composting
- forced air assisted solid phase continuous flow composting.

In each case, aeration would be provided by subgrade collection ducts drawing air from the atmosphere through the impoundment materials for treatment and discharge. Windrow mixing would typically be provided by a straddle-type tiller, while the continuous system provides a mechanical tiller that tracks along bay walls containing the treatment medium. In the latter case, material to be treated is also moved forward a pre-determined distance allowing material to be added at the feed end and removed at the opposite end. Moisture and nutrient levels would be monitored and maintained, as necessary, based on the results of the pre-design testing. Biological treatment using indigenous microorganisms with a treatment duration of 21 days is anticipated. A portion of the finished compost may be recycled to the feed, however, to reduce acclimation or lag time. Finished compost may be cured in passive piles if additional polishing is required.

Treated low Btu value tar/sludge materials would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Post-conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture.

Final placement. Treated low Btu value tar/sludge materials (finished compost) would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material (finished compost) meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundments.

Completion of remedial activities associated with Alternative B3 would be within approximately 5 to 7 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.2.4. Alternative B4 - LTTT

Alternative B4, LTTT, treatment of the material using LTTT to achieve Group III treatment objectives, and placement of the treatment residuals in the Impound 8 facility. A conceptual treatment train diagram for the LTTT alternative is presented as Figure 6-2.

Material handling. Low Btu value tar/sludge material would be removed from the impoundments using standard excavation techniques, such as a long-reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the low Btu value materials in Impoundments 4, 5, and 14, as described in Section 6.5.2. Engineering controls, such as a water, foam, or membrane cover, would be utilized during excavation to minimize VOC emissions and associated odors. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Excavated material would be pre-treated as necessary to condition the material prior to processing in the LTTT component. As described in Section 3.4.6, pretreatment would consist of TEMD, which would accomplish detackification, neutralization, and reduction of organic constituents using mixing equipment, controlled volatilization, and thermal desorption. Low Btu value tar/sludge materials would be mixed with portland cement and limestone aggregate in mixing equipment, such as a pugmill, to detackify and neutralize the materials for subsequent materials handling and treatment. The mixing process would generate heat through hydration (approximately 100 to 150° F), which would assist in VOC and SVOC removal during mixing. The pretreatment step would also include off-gas control, such as condensation, carbon adsorption, or thermal oxidation. Gas scrubbing and particulate control may also be necessary for inorganic acid gases and particulates that may be evolved during processing.

Subsequent to pretreatment, the material will be treated via LTTT. Based on treatability testing for Impoundment 1 and 2 materials, the LTTT system will operate at a material processing temperature of approximately 300°F at a residence time of approximately 15 min. These operating parameters were demonstrated to remove VOCs and SVOCs to the Group III treatment objectives. Either aerobic or anaerobic LTTT processing was demonstrated as meeting the Group III treatment objectives during the treatability testing at these operating parameters. Actual full-scale operating parameters may be modified depending on the nature of the pre-treated material and extent of organic removal necessary to achieve the treatment objectives. Similar to pretreatment, the vapors generated during LTTT would be collected and treated by a vapor treatment train which may use one or more of the following technologies: dust collection, acid gas scrubbing, condensation, adsorption or thermal oxidation.

Treated low Btu value tar/sludge materials would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Strength conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture.

Final placement. Treated low Btu value tar/sludge materials would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundments.

Completion of remedial activities associated with Alternative B4 would be within approximately 3 to 4 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phase.

6.2.5. Alternative B5 - on-site incineration

Alternative B5 , on-site incineration , involves treatment of the material on-site using incineration to achieve Group III treatment objectives, and placement of the treatment residuals in the Impound 8 facility. A conceptual treatment train diagram for the on-site incineration alternative is presented as Figure 6-3.

Material handling. Low Btu value tar/sludge material would be removed from the impoundments using standard excavation techniques, such as a long-reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the low Btu value materials in Impoundments 4, 5, and 14, as described in Section 6.5.2. Engineering controls, such as a water, foam, or membrane cover, would be utilized during excavation to minimize VOC emissions and associated odors. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Excavated material would be pre-treated as necessary to condition the material prior to processing in an on-site incineration unit. If pretreatment is necessary, material addition would be implemented in mixing equipment, such as a pugmill. Pretreatment would include off-gas control, such as condensation, carbon adsorption, or thermal oxidation. Particulate control may also be necessary for dust that may be evolved during processing.

The low Btu value tar/sludge material would be processed through an incineration unit on-site to remove VOCs and SVOCs to achieve the Group III treatment objectives. The incinerator will be strategically placed to reduce material handling requirements during treatment. The vapors generated during incineration would be collected and treated by a vapor treatment train which may use one or more of the following technologies: dust collection, acid gas scrubbing, condensation, adsorption or thermal oxidation.

Residual ash would be post-conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Post-conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture.

Final placement. Residual ash would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundments.

Completion of remedial activities associated with Alternative B5 would be within approximately 4 to 5 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.3. Category C: Impoundment 3

Four remedial alternatives were developed for the Impoundment 3 material. The four remedial alternatives identified include no action/institutional actions, consolidation in Impound 8, LTTT, and on-site incineration. These alternatives are summarized in Section 4. A treatment train for the Impoundment 3 material, consisting of pretreatment, treatment, and post-conditioning, was developed for LTTT and on-site incineration alternatives. Material will be treated through the components of the treatment train until the treatment objectives are achieved. Based on the heterogeneity of the material, in some instances the treatment objectives would be met prior to implementation of more active treatment technologies. Once the treatment objectives are met, the material will be placed in Impound 8.

6.3.1. Alternative C1 - no action/institutional actions

Alternative C1, no action/institutional actions, as required by the NCP, provides a baseline for comparison to the other alternatives. Alternative C1 consists of only access restrictions and monitoring. Access restrictions would include maintenance of the existing site controls which restrict access to Impoundment 3, as well as future land use restrictions due to the continuing presence of the Impoundment 3 material in place. Ground water monitoring would be performed as part of Alternative C1 to track the impact to site ground water from the Impoundment 3 material.

6.3.2. Alternative C2 - consolidation in Impound 8

Alternative C2 involves excavation of the Impoundment 3 material and placement of the material into the Impound 8 facility. A conceptual treatment train diagram for the consolidation in Impound 8 alternative is presented as Figure 6-1.

Material handling. Impoundment 3 material would be removed from the impoundments using standard excavation techniques, such as a long reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the Impoundment 3 materials, as described in Section 6.5.2. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Conditioning. Excavated material would be conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture. Conditioning would include off-gas control such as condensation, carbon adsorption, or thermal oxidation. Particulate control may also be necessary for particulates that may be evolved during processing.

Final placement. Prior to placement into Impound 8, Impoundment 3 materials would be sampled and analyzed to confirm achievement of unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of evaluation sampling and analysis would be identified during remedial design. Material exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8, the on-site permitted, hazardous waste management facility.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundment. In the interim the impoundment will be controlled by maintenance of the berms.

Completion of remedial activities associated with Alternative C2 would be within approximately 1 year including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.3.3. Alternative C3 - LTTT

Alternative C3, LTTT, involves removal of Impoundment 3 material, treatment of the material using LTTT to achieve Group III treatment objectives, and placement of the treatment residuals in the Impound 8 facility. A conceptual treatment train diagram for the LTTT alternative is presented as Figure 6-2.

Material handling. Impoundment 3 material would be removed from the impoundments using standard excavation techniques, such as a long reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the Impoundment 3 materials, as described in Section 6.5.2. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Excavated material would be pre-treated as necessary to condition the material prior to processing in the LTTT component. As described in Section 3.4.6, pretreatment would consist of TEMD, which would accomplish detackification, neutralization, and reduction of organic constituents using mixing equipment, controlled volatilization, and thermal desorption. Impoundment 3 material would be mixed with portland cement and limestone aggregate in mixing equipment, such as a pugmill, to detackify and neutralize the materials for subsequent materials handling and treatment. The mixing process would generate heat through hydration (approximately 100 to 150°F), which would assist in VOC and SVOC removal during mixing. The pretreatment step would also include off-gas control, such as condensation, carbon adsorption, or thermal oxidation. Gas scrubbing and particulate control may also be necessary for inorganic acid gases and particulates that may be evolved during processing.

Subsequent to pretreatment the material will be treated by LTTT. Based on treatability testing for Impoundment 1 and 2 materials, the LTTT system will operate at a material processing temperature of approximately 300°F at a residence time of approximately 15 min. These operating parameters were demonstrated to remove VOCs and SVOCs to the Group III treatment objectives. Either aerobic or anaerobic LTTT processing was demonstrated as meeting the Group III treatment objectives during the treatability testing at these operating parameters. Actual full-scale operating parameters may be modified depending on the nature of the pre-treated material and extent of organic removal necessary to achieve the treatment objectives. Similar to pretreatment, the vapors generated during LTTT would be collected and treated by a vapor treatment train which may use one or more of the following technologies: dust collection, acid gas scrubbing, condensation, adsorption or thermal oxidation.

Treated Impoundment 3 material would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Strength conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture.

Final placement. Treated Impoundment 3 material would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements, and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundment.

Completion of remedial activities associated with Alternative C3 would be within approximately 1 to 2 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.3.4. Alternative C4 - on-site incineration

Alternative C4, on-site incineration, involves treatment of the material on-site using incineration to achieve Group III treatment objectives, and placement of the treated materials in the Impound 8 facility. A conceptual treatment train diagram for the on-site incineration alternative is presented as Figure 6-3.

Material handling. Impoundment 3 material would be removed from the impoundments using standard excavation techniques, such as a long reach excavator, backhoe, or clamshell and crane. The excavations would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the Impoundment 3 materials, as described in Section 6.5.2. Excavated materials may be placed in a temporary staging area prior to treatment. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Excavated material would be pre-treated as necessary to condition the material prior to processing in an on-site incineration unit. If pretreatment is necessary, material addition would be implemented in mixing equipment, such as a pugmill. Pretreatment would include off-gas control, such as condensation, carbon adsorption, or thermal oxidation. Particulate control may also be necessary for dust that may be evolved during processing.

The Impoundment 3 material would be processed through an incineration unit on-site to remove VOCs and SVOCs to achieve the Group III treatment objectives. The vapors generated during incineration would be collected and treated by a vapor treatment train which may use one or more of the following technologies: dust collection, acid gas scrubbing, condensation, adsorption or thermal oxidation.

Residual ash would be post-conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Post-conditioning would involve the addition of stabilizing agents such as portland cement, sodium silicate, and moisture in mixing equipment, such as a pugmill.

Final placement. Residual ash would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements, and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities will be determined based on the requirements for the soils beneath the impoundments. The impoundment will be controlled by maintenance of the berms.

Completion of remedial activities associated with Alternative C4 would be within approximately 1 to 3 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.4. Category D: Non-hazardous material

Four remedial alternatives were developed for Category D. As discussed in Sections 4 and 5 of the April 1996 Group III CMS/FS, existing TCLP characterization data indicate that the non-sludge (Impoundment 5 dry fill and Impoundment 26) material does not exhibit the characteristics of a RCRA hazardous waste. Based on comments received from the NJDEP and USEPA on the Draft Group III CMS/FS , treatment of the Category D materials should be addressed within the CMS/FS based on the total contaminant levels within Impoundments 5 dry and 26. Consequently, the alternatives assembled include no action/institutional actions, treatment via bioremediation, off-site disposal as a non-hazardous waste, and consolidation in Impound 8. Treatment of the material would be triggered by exceedances above treatment objectives.

6.4.1. Alternative D1 - no action/institutional actions

Alternative D1, no action/institutional actions, required by the NCP, provides a baseline for comparison to the other alternatives. Alternative D1 consists of only access restrictions and monitoring. Access restrictions would include maintenance of the existing site controls which restrict access to the impoundments as well as future land use restrictions due to the continuing presence of the fill material in place. Ground water monitoring would be performed as part of Alternative D1 to track the impact to site ground water from the impoundments. Monitoring and maintenance of tar seeps would also be performed.

6.4.2. Alternative D2 - bioremediation with final placement in Impound 8

Alternative D2, solid-phase bioremediation, involves treatment of the material using solid-phase bioremediation and placement of the treated materials in the Impound 8 facility. A conceptual treatment train is provided in Figure 6-4.

Material handling. The Category D material would be removed from the impoundments using standard excavation techniques, such as long-reach excavator, backhoe, or clamshell and crane. The excavation would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the impoundment materials. Section 6.5.2. provides a detailed discussion for the debris handling. Excavated material may be placed in a temporary staging area. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Biological processing using modified compost or aerated pile techniques would be used for treatment. Compost process alternative include:

- forced air assisted windrow composting
- forced air assisted solid phase continuous flow composting

In each case, aeration would be provided by subgrade collection ducts drawing air from the atmosphere through the impoundment materials for treatment and discharge. Windrow mixing would typically be provided by a straddle-type tiller, while the continuous mixing provides a mechanical tiller that tracks along bay walls containing the treatment medium. In the latter case, material to be treated is also moved forward a pre-determined distance allowing material to be added at the feed end and removed at the opposite end. Moisture and nutrient levels would be monitored and maintained, as necessary, based on the results of the pre-design testing. Biological treatment using indigenous microorganisms with a treatment duration of 21 days is anticipated. A portion of the finished compost may be recycled to the feed, however, to reduce acclimation or lag time. Finished compost may be cured in passive piles if additional polishing is required.

The treated material would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Post-conditioning would involve the addition of stabilizing agents as Portland cement, sodium silicate, and moisture.

During the remedial design, the viability of utilizing the category D material as an admixture for other material categories will be addressed.

Final placement. Treated Category D material (finished compost) would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern, unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of treatment evaluation sampling and analysis would be identified during the remedial design. Treated material (finished compost) meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities would be determined based on the requirements for the soils beneath the impoundments.

Completion of remedial activities associated with Alternative D2 would be within approximately 2 to 3 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which wouldl be refined during the remedial design and construction phases.

6.4.3. Alternative D3 - off-site disposal

Alternative D3, off-site disposal, involves excavation of the Category D materials and transportation off-site for disposal in a non-hazardous landfill.

Material handling. The Category D material would be removed from the impoundments using standard excavation techniques, such as long-reach excavator or backhoe. The excavations would include 6 inches of soil beneath the impoundment material. Debris would be separated from the impoundment materials, as described in Section 6.5.2. of the CMS. Excavated material may be placed in a temporary staging area. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Off-site transport and disposal. The Category D material will be transported off-site by a licensed waste transporter to a non-hazardous waste landfill. Pre-treatment of the category D material is not anticipated based on the soil-like nature of the material.

Site restoration. Final site restoration activities would be determined based on the requirements for the soils beneath the impoundments.

Completion of remedial activities associated with Alternative D3 would be within approximately 1 to 2 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.4.4. Alternative D4 - consolidation in Impound 8

Alternative D4, involves excavation of the non-hazardous material and placement of the material in the Impound 8 facility. A conceptual treatment train is provided in Figure 6-1.

Material handling. The Category D material would be removed from the impoundments using standard excavation techniques, such as long-reach excavator or backhoe. The excavations would include 6 inches of soil beneath the impoundment material. Debris would be separated from the impoundment materials, as described in Section 6.5.2. of the CMS. Excavated material may be placed in a temporary staging area. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Conditioning. Excavated material would be conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Conditioning would involve the addition of stabilizing agents such as Portland cement, sodium silicate, and moisture.

Final placement. Prior to placement into Impound 8, materials would be sampled and analyzed to confirm achievement of unconfined compressive strength requirements and TCLP limits for metals in the event that pre-treatment material does not pass this criteria. The frequency of evaluation sampling and analysis would be identified during remedial design. Material exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8, the on-site permitted, hazardous waste management facility.

Site restoration. Final site restoration activities would be determined based on the requirements for the soils beneath the impoundments.

Completion of remedial activities associated with Alternative D4 would be within approximately 1 to 2 years including time for preconstruction activities (e.g., contract procurement, operations plan development, permitting); material excavation and processing; placement in Impound 8; site restoration; and demobilization. The timeframe will be dependent on equipment size and throughput rates, which would be refined during the remedial design and construction phases.

6.5. Category E: General plant debris

Two remedial alternatives were developed for general plant debris expected to be encountered in the Group III Impoundments. As discussed in Sections 4 and 5, general plant debris is not anticipated to exhibit the characteristics of a RCRA hazardous waste, and is therefore not anticipated to require treatment prior to land disposal. Consequently, the alternatives identified for general plant debris include 1) no action/institutional actions and 2) consolidation in Impound 8. For consolidation into Impound 8, debris would be removed from the impoundments. Free sludge material is anticipated to be limited to surfaces, thus not affecting the bulk of the debris.

6.5.1. Alternative E1 - no action

Alternative E1, no action, as required by the NCP, provides a baseline for comparison to the other alternatives. Because the nature of the general plant debris is such that it is mixed with other materials in the Group III impoundments, Alternative E1 could only be realistically implemented in combination with Alternatives B1, C1, and D1.

6.5.2. Alternative E2 - consolidation in Impound 8

Alternative E2 involves placement of general plant debris, following removal from the Group III Impoundments, in the Impound 8 facility. Placement directly into Impound 8 is anticipated since debris would not be expected to exhibit hazardous waste characteristics.

Material handling. General plant debris would be removed from the Group III Impoundment using standard excavation techniques, such as clamshells, cranes, long-reach excavators, or backhoes. Debris would be mechanically separated from other impoundment materials, and large debris (e.g., larger than approximately 5 ft by 5 ft by 5 ft) would be crushed to improve handling. Free sludge material, anticipated to be limited mainly to surface staining, would be removed. Debris may be placed in a temporary staging area prior to disposal.

Final placement. General plant debris would be transported to and placed in Impound 8, the on-site permitted, waste management facility. To minimize the potential for damage of geotextile, placement of debris should be no closer than 2 ft from any geotextile, geomembrane, or geosynthetic material, and debris should not be placed above the sideslopes where the gravel primary leachate layer is present.

7. Potentially applicable or relevant and appropriate requirements (ARARS)

One of the nine CERCLA screening criteria outlined in the NCP, which used in the detailed analysis of alternatives in Section 8, is compliance with ARARs. ARARs are federal, state or local regulations that are legally applicable or that may be relevant or appropriate to the proposed remedial alternatives. ARARs are generally grouped into three categories: chemical-specific, location-specific, and action-specific. Table 7-1 presents these ARARs with respect to each alternative developed for the Group III material categories. A fourth category, "to be considered" (TBC) material, refers to information, such as draft regulation or guidance, that is not law or a promulgated standard.

7.1. Chemical-specific ARARs

Chemical-specific ARARs establish the acceptable amount or concentration of chemicals that will remain in the ambient environment. They typically include standards for ground water, surface water, and air. There are no chemical-specific ARARs for sludges. Universal Treatment Standards (UTSs) are chemical-specific ARARs that will be triggered if the waste is removed from the Group III Impoundments for disposal elsewhere (including Impound 8). There are three possible ways to comply with this requirement: 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels), or 3) granting a CAMU and developing alternate treatment standards. Compliance with ARARs will be achieved in one of these three manners.

7.2. Location-specific ARARs

Location-specific ARARs are tied to site characteristics. Each of the Group III impoundments is located within the 100 year floodplain (FEMA 1989). Accordingly, New Jersey's Flood Hazard Control Act Regulations (N.J.A.C. 7:13-1, et-seq) are potentially applicable. In addition, Impoundment 20 is located in a transitional wetland area (O'Brien & Gere 1996). Accordingly, New Jersey's Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A-1 et seq) and the Nationwide Permit Program under Section 404 of the Clean Water Act (33 C.F.R. Part 330) are potentially applicable. Cultural Resources and Stream Encroachment are potentially applicable ARARs for Impoundments 1 and 2.

7.3. Action-specific ARARs

Action-specific ARARs apply to particular activities to be undertaken during site remediation. These include the requirements of the 1988 ACO (as amended May 4, 1994); NJDEP Technical Requirements for Site Remediation (N.J.A.C. 7:26E et seq); New Jersey Soil Erosion and Sediment Control Act Requirements (N.J.A.C. 2:90-1.1 et seq and 4:24-42); OSHA General Industry Standards for Hazardous Waste Operations and Emergency Responses (29 C.F.R. 1910.120); OSHA Construction Industry Safety and Health Standards (29 C.F.R. Part 1926); and OSHA Recordkeeping, Reporting and Related Regulations (29 C.F.R. Part 1904).

Excavation and management of hazardous wastes will be subject to New Jersey Solid and Hazardous Waste Regulations, including General Provisions (N.J.A.C. 7:26-1), Labeling and Recordkeeping Requirements (N.J.A.C. 7:26-7), and Hazardous Waste Criteria, Identification and Listing Provisions (N.J.A.C. 7:26-8). Excavation and materials handling are potential non-point sources for VOC emissions, and treatment processes are potential point sources for VOC and SVOC emissions. Accordingly, New Jersey's Air Pollution Control Regulations (N.J.A.C. 7:27) and the National Ambient Air Quality Standards (40 C.F.R. Part 50) are potentially applicable. Transportation of material to Impound 8 would be subject to transportation requirements, including DOT Rules for Hazardous Materials Transport (49 C.F.R. 172, 173, 177, and 178), New Jersey Solid and Hazardous Waste Transportation Regulations (N.J.A.C. 7:26-3), and New Jersey Hazardous Waste Transporter Responsibilities (N.J.A.C. 7:26-7.5).

Land Disposal Restrictions (LDRs) and UTSs are potential action-specific ARARs for management of wastes for Group III Impoundments. Compliance with LDRs and UTSs may be achieved in one of the following three ways:

- achieving the UTSs
- obtaining a treatability variance for soil and debris (using EPA Superfund LDR Guide 6A)
- granting a CAMU and developing alternate treatment standards.

Designation of a CAMU would not trigger LDRs and UTSs. Placement of waste into or within a CAMU does not constitute land disposal of hazardous wastes. 40 C.F.R. 254.552(a)(1). Instead, the CAMU regulations are themselves ARARs (they are legally applicable) for placement of waste into a duly designated CAMU. However, the Regional Administrator must determine that the CAMU designation will facilitate "reliable, effective, protective, and cost-effective remedies," 40 C.F.R. 264.522 (c)(1), and "minimize future releases, to the extent practicable." Id at 552(c)(4). In addition, the Regional Administrator may require treatment "as appropriate," to enhance the long-term effectiveness of the remedial actions at the facility by reducing the toxicity, mobility, or volume of the wastes that will remain in place after closure of the CAMU. Id at 264.552(c)(6).

Cyanamid submitted a petition to USEPA seeking designation of Impound 8 as a CAMU in February 1995 (McDonald 1995). USEPA requested additional information prior to designation of the CAMU, specifically remediation goals for the Group III impoundment materials, as well as the other site wastes (Basso 1995). NJDEP directed that a revised petition for designation of Impound 8 as a CAMU be submitted together with the results of the supplemental treatability studies and this redeveloped CMS/FS report. The revised petition was submitted to USEPA in May 1996 and requests designation of Impound 8 as a CAMU.

7.4. TBC's

No TBCs have been identified for the Group III impoundment materials.

8. Detailed analysis of alternatives

The screening of alternatives follows the development of alternatives and precedes the detailed analysis of alternatives in the CERCLA FS process. In this phase, alternatives are screened based on effectiveness, implementability, and cost so as to reasonably focus the number of alternatives undergoing detailed analysis. The screening and evaluation of technologies for specific material categories was sufficient to reduce the number of alternatives for detailed analysis. Between two and five alternatives have been developed for each Group III impoundment material category. Because this number of alternatives was deemed manageable for detailed analysis, the screening of alternatives prior to detailed analysis was not required.

The objective of the detailed analysis of alternatives is to analyze and present sufficient information to allow the remedial alternatives to be compared and a remedial action selected for the site. The detailed analysis of alternatives consisted of an individual assessment of each alternative with respect to nine evaluation criteria outlined in the NCP. The detailed evaluation also included a comparative evaluation among alternatives designed to consider the relative performance of the remedial alternatives.

8.1. Evaluation criteria

Each remedial alternative for each material category was evaluated individually with respect to the nine NCP evaluation criteria. The nine CERCLA screening criteria are grouped into the following three categories to highlight their purpose in the detailed analysis process:

- Threshold criteria
- Balancing criteria
- Modifying criteria.

The threshold criteria must be satisfied for an alternative to be considered further as a potential remedial alternative. These criteria are not compromised when selecting the final alternative. An alternative will be eliminated from consideration if it does not satisfy the threshold criteria.

The balancing criteria are those criteria which are assessed to highlight the merits of individual alternatives when compared to one another. The balancing criteria are used as an additional tool for evaluating those alternatives which fully satisfy the threshold criteria. Unlike the threshold criteria, all of the balancing criteria need not be satisfied for an alternative to be selected, but those alternatives which satisfy more balancing criteria than other alternatives will be considered more appropriate.

The modifying criteria are assessed to distinguish an alternative from other alternatives, based on public and agency opinion, when the balancing criteria are not sufficient to complete this task. After the threshold and balancing criteria assessments, the alternative which is deemed most appropriate must satisfy the modifying criteria. Each of the nine CERCLA screening criteria is described below.

Threshold criteria

Overall protection of human health and the environment This criterion provides an evaluation of how an alternative eliminates or reduces the risk from potential exposure pathways through treatment, engineering, or institutional controls. Satisfaction of this criterion assures that, when implemented, the remedy will result in adequate protection to human health and the environment.

Compliance with ARARs All remedial alternatives are evaluated to determine whether they attain federal and state ARARs. The ARARs were identified in Section 7.

Balancing criteria

Long-term effectiveness and permanence Long-term effectiveness and permanence are evaluated based on the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining material over the long term. Alternatives that afford the highest degree of long-term effectiveness and permanence minimize residual contamination; hence, the need for long-term maintenance and monitoring programs and reliance on institutional controls are minimized.

Reduction of toxicity, mobility, or volume through treatment This criterion evaluates the anticipated treatment level of performance of the remedial alternatives based on the Group III treatment objectives. This evaluation focuses on the statutory preference for selecting a remedial action that uses treatment to reduce the toxicity, mobility, or volume of hazardous substances. Factors influencing the evaluation of this criterion include quantity of waste treated, recycled, or destroyed; irreversibility of treatment; and the type, quantity, and toxicity of residuals resulting from the treatment.

Short-term effectiveness The short-term effectiveness criterion takes into account protection of workers and the community during the remedial action, environmental impacts from implementing the action, and the time required to complete the cleanup.

Implementability Analysis of implementability is used to evaluate the technical and administrative feasibility of implementing the alternatives, as well as the availability of the treatment technology and its components. This includes commercial availability of equipment, the ability to monitor the performance and effectiveness of technologies, and the ability to obtain necessary regulatory approvals.

Cost Capital costs, annual operating and maintenance costs, and present worth costs are estimated on the order of +50/-30 percent. Feasibility study level cost estimates are prepared as guidance in evaluating remedial alternative project costs for implementation and monitoring. Actual costs will depend on true labor and material costs, final project scope, implementation schedule, and other associated factors. Because the impoundments were broken into groups for analysis of remedial alternatives, the costs were calculated independently. Equipment retrofitting and re-mobilization is to be expected even if the same technology is to used for different material categories; therefore mobilization costs are relevant regardless of the technology selected for each material category.

Modifying criteria

USEPA acceptance At the agencies' request, satisfaction of this criterion will be determined after submittal of this report; thus, this criterion is not evaluated in this section.

Community acceptance At the agencies' request, this criterion will be assessed following submittal of the CMS/FS Report, during the public comment period for the proposed plan; thus, this criterion is not evaluated in this section.

The remainder of this section provides the detailed analysis of alternatives for each Group III material category. Key components of this analysis include the ability to meet Group III treatment objectives and the placement of the material in Impound 8, a permitted, triple lined waste management facility. These two components establish the overall framework for evaluating the NCP criteria for the Group III impoundments under a CAMU designation for Impound 8.

8.2. Category A: High Btu tar

8.2.1. Individual analysis of alternatives

The remedial alternatives which are being evaluated for the high Btu tar include:

- Alternative A1 - no action/institutional actions
- Alternative A2 - consolidation in Impound 8
- Alternative A3 - LTTT
- Alternative A4 - on-site incineration.

The individual analysis of alternatives for the high Btu tar with respect to the nine evaluation criteria is documented in Table 8-1. Detailed cost estimates for Alternatives A1, A2, A3, and A4 are presented in Tables 8-2, 8-3, 8-4, and 8-5. For Alternatives A2, A3, and A4, O&M costs associated with the Impound 8 facility were not included in the alternative cost estimates as they were deemed comparable for each alternative.

8.2.2. Comparative analysis of alternatives

Overall protection of human health and the environment. Alternative A1 would not provide overall protection of human health and the environment, while Alternatives A2, A3, and A4 would provide equivalent protection through removal and containment of the tars in the Impound 8 facility Alternatives A2, A3, and A4 would minimize human exposure to the high Btu tar/sludge material and minimize constituent migration through removal and containment of the tars in Impound 8. Alternatives A3 and A4 would provide an increased level of protectiveness through active treatment, with Alternative A4 providing the highest level of overall protection with the highest degree of contaminant removal through incineration.

Compliance with ARARs. There are no chemical-specific ARARs associated with Alternative A1. UTSs specified in EPA's LDRs are chemical-specific ARARs for Alternatives A2, A3, and A4 as the material would be removed from the impoundments and disposed in Impound 8. There are three possible options to comply with this requirement: 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels), or 3) granting a CAMU and developing alternative treatment standards. For Alternative A2, the third option associated with alternative treatment standards under a CAMU is the only way to meet this ARAR based on raw material characterization. LTTT testing performed to evaluate Alternative A3 proved that the treated material also did not achieve UTSs or treatability variance levels using the 6A guidance levels. Therefore, option 3 is also the only way for Alternative A3 to meet the ARAR. Alternative A4, on-site incineration, would be expected to meet either option 1 or option 2 through destruction of the organic material. Alternatives A2, A3, and A4 would each meet the chemical-specific ARAR.

The New Jersey Flood Hazardous Control Act Regulations (NJAC 7:13 et. seq.) would be a location-specific ARAR for each of the alternatives. This ARAR would be met through specifying the substantive floodplain requirements in the remedial action contract and by maintaining compliance through remedial action monitoring. In addition, the New Jersey Standards for New Hazardous Waste Facilities (NJAC 7:26-10.3) would be another location-specific ARAR for Alternatives A2, A3, and A4 as placement of the materials would be in Impound 8. This ARAR would be met for these alternatives by specifying the substantive requirements in the remedial action contract and by maintaining compliance with those requirements through remedial action monitoring. Each of the Alternatives A2, A2, A3, and A4 would therefore meet location-specific ARARs.

Action-specific ARARs identified for Alternatives A1, A2, A3, and A4 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARs would be met through specifying the substantive requirements in the remedial action contract and by monitoring compliance during inspection activities. Additional action-specific ARARs would be triggered for Alternatives A2, A3. and A4 due to material excavation, conditioning and/or treatment, and placement in Impound 8. These ARARs would include New Jersey air regulations; SESC requirements; New Jersey Hazardous waste regulations related to residual waste disposal; DOT transport requirements; RCRA regulations pertaining to Impound 8; cultural resources and stream encroachment. These ARARs would also be met through specification of the substantive requirements in the remedial action contract documents and during remedial action monitoring to maintain compliance. Each of the Alternatives A1, A2, A3 and A4 would meet action specific ARARs.

Long-term effectiveness and permanence. Alternative A1 would provide for future limitation of contact through fencing and land use restrictions and for minimizing potential risks associated with VOC emissions via water covers/liners. Each of these measures is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents remain since the high Btu tar would remain in-place within the impoundments. Alternative A1, therefore, would not provide long-term effectiveness. Alternatives A2, A3, and A4 would provide long-term effectiveness by minimizing residual risk through removal, solidification for strength and reduction of metals leachability, and containment of the high Btu tars in the Impound 8 facility. Each of these measures is an adequate and reliable method for minimizing human exposure and minimizing migration of the tar constituents. Alternatives A3 and A4 would further minimize human exposure and enhance long-term effectiveness through treatment with Alternative A4 providing increased long-term effectiveness with the highest degree of contaminant removal through incineration. Alternatives A3 and A4 would permanently reduce the levels of contaminants that are present in the impoundment materials.

Reduction of toxicity, mobility, or volume through treatment. Alternative A1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternative A2 (consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in Impound 8. A slight material volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternative A3 (LTTT) offers a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. A net material volume increase of 25% is expected due to pre-LTTT conditioning and post-LTTT conditioning with admixtures. Alternative A4 offers the greatest reduction in containment mass and toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net material volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative A4 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through incineration. Alternatives A3 and A4 would permanently reduce the levels of contaminants that are present in the impoundment materials.

Short-term effectiveness. Alternative A1 would provide for short-term effectiveness through limitation of contact with the high Btu tar through fencing and land use restrictions. The water cover/liner would also limit contact with the material by limiting VOC emissions from Impoundments 1 and 2. However, the material within these Impoundments would continue to act as a continuing source of impact to soil and ground water in Alternative A1. In Alternatives A2, A3, and A4, the community would be restricted from access to the site during remediation through locking gates currently in-place and an existing manned guardpost. Appropriate protective equipment would be used during monitoring activities in Alternative A1 and in remedial activities in Alternatives A2, A3, and A4. Appropriate mitigation measures would be implemented to control vapor emissions/odors during excavation and treatment of the high Btu tar in Alternatives A2, A3, and A4. With respect to Alternatives A2 and A3, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts. Use of appropriate controls would therefore provide for equivalent short-term effectiveness with respect to human health in each of Alternatives A1, A2, A3, and A4. Alternatives A2, A3, and A4 would provide for equivalent short-term effectiveness with respect to the environment with appropriate controls, while environmental impacts would not be minimized in Alternative A1 since migration of constituents could continue for the in-place material.

With respect to the RAOs, Alternative A1 would not minimize migration of constituents. Alternatives A2, A3, and A4 would achieve RAOs upon completion of remedial activities. Completion of remedial activities associated with Alternative A2 would be within approximately 1 to 2 yr. Completion of remedial activities associated with Alternative A3 and Alternative A4 would be within approximately 2 to 5 yr. Alternatives A2, A3, and A4 would provide protection of human health and the environment, limit construction worker contact with high Btu tars, and avoid activities which could cause the mobilization of contaminants. Alternative A1 would not attain RAOs, but it can be implemented immediately. Of the remaining alternatives, Alternative A2 is better than Alternatives A3 and A4 because it can achieve the RAOs in a shorter timeframe than Alternatives A3 and A4.

Implementability. Alternatives A1 and A2 are readily implementable. Alternative A3 is also feasible based upon the 1995 and 1996 LTTT pilot study results (Appendix A). Alternative A4 is considered to be moderately implementable with the same requirements as A3. Coordination with the NJDEP would be required for implementing air controls and conducting remedial actions for Alternatives A2, A3, and A4. The technologies presented in Alternatives A2, A3, and A4 are considered to be reliable and effective at meeting the Group III treatment objectives. Impound 8 is considered to be readily available to receive treated materials from Alternatives A2, A3, and A4. Alternative A1 is most readily implementable. Of the remaining alternatives which attain RAOs, Alternative A2 is most implementable.

Cost. Capital costs for each alternative were estimated. O&M and total present worth costs were also estimated for Alternative A1. Alternative A1 was the least expensive alternative, followed by A2, A3, and A4, respectively.

A cost comparison of alternatives is presented as follows:

Alternative	Capital	O&M	30-Yr Present Worth
A1 (No action/institutional actions)	$56,000	$14,000	$230,000
A2 (Consolidation in Impound 8)	$19,000,000	N/A	$19,000,000
A3 (LTTT)	$27,000,000	N/A	$27,000,000
A4 (On-site Incineration)	$35,000,000	N/A	$35,000,000

USEPA acceptance. Regulatory agency acceptance will be documented in the ROD.

Community acceptance. Community and local government are opposed to on-site incineration.

8.3. Category B: Low Btu tar/sludge

8.3.1. Individual analysis of alternatives

The remedial alternatives which are being evaluated for the low Btu tar/sludge include:

- Alternative B1 - no action/institutional actions
- Alternative B2 - consolidation in Impound 8
- Alternative B3 - bioremediation
- Alternative B4 - LTTT
- Alternative B5 - on-site incineration.

The individual analysis of alternatives for the low Btu tar with respect to the nine evaluation criteria is documented in Table 8-6. Detailed cost estimates for Alternatives B1, B2, B3, B4, and B5 are presented in Tables 8-7, 8-8, 8-9, 8-10, and 8-11. For Alternatives B2, B3 , B4, and B5, O&M costs associated with overall O&M of the Impound 8 facility were not included in the alternative cost estimates as they were deemed comparable for each alternative.

8.3.2. Comparative analysis of alternatives

Overall protection of human health and the environment. Alternative B1 would not provide overall protection of human heath and the environment, while Alternatives B2, B3, B4, and B5 would provide equivalent protection through removal and containment of the low Btu tar/sludge in Impound 8. Alternatives B2, B3, B4, and B5 would minimize human exposure to the low Btu tar/sludge material and minimize constituent migration through removal and containment of the tars in Impound 8. Alternatives B3, B4 and B5 would provide an increased level of protectiveness through treatment of the low Btu tar/sludge, with Alternative B5 providing the highest level of overall protection of human health and the environment with the highest degree of contaminant removal through incineration.

Compliance with ARARs. There are no chemical-specific ARARs associated with Alternative B1. UTSs specified in EPA's LDRs are chemical-specific ARARs for Alternatives B2, B3, B4, and B5 as the material would be removed from the impoundments and disposed in Impound 8. There are three possible ways to comply with this requirement: 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels), or 3) granting a CAMU and developing alternative treatment standards. For Alternative B2, the third option associated with alternative treatment standards under a CAMU is the only way to meet this ARAR based on raw material characterization. Bioremediation testing performed to evaluate Alternative B3 proved that the treated material also did not achieve UTSs or treatability variance levels using the 6A guidance levels. It is expected that LTTT would also not achieve UTSs or treatability variance levels using 6A guidance levels. Therefore, option 3 is also the only way for Alternatives B3 and B4 to meet the ARAR. Alternative B4, on-site incineration, would be expected to meet either option 1 or option 2 through destruction of the organic material. Alternatives B2, B3, B4, and B5 would each meet the chemical-specific ARAR.

The New Jersey Flood Hazardous Control Act Regulations (NJAC 7:13 et. seq.) would be a location-specific ARAR for each of the alternatives. This ARAR would be met through specifying the substantive floodplain requirements in the remedial action contract and by maintaining compliance through remedial action monitoring. In addition, the New Jersey Standards for New Hazardous Waste Facilities (NJAC 7:26-10.3) would be another location-specific ARAR for Alternatives B2, B3, B4, and B5 as placement of the materials would be in Impound 8. This ARAR would be met for these alternatives by specifying the substantive requirements in the remedial action contract and by maintaining compliance with those requirements through remedial action monitoring. Each of Alternatives B1, B2, B3, B4, and B5 would meet the location-specific ARARs.

Action-specific ARARs identified for Alternatives B1, B2, B3, B4, and B5 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARs would be met through specifying the substantive requirements in the remedial action contract and by monitoring compliance during inspection activities. Additional action-specific ARARs would be triggered for Alternatives B2, B3, B4 and B5 due to material excavation, conditioning and/or treatment, and placement in Impound 8. These ARARs would include New Jersey SESC requirements; New Jersey Hazardous waste regulations related to residual waste disposal; DOT transport requirements; and RCRA regulations pertaining to Impound 8. These ARARs would also be met through specification of the substantive requirements in the remedial action contract documents and during remedial action monitoring to maintain compliance. Each of Alternatives B2, B2, B3, B4, and B5 would meet the action-specific ARARs.

Long-term effectiveness and permanence. Alternative B1 would provide for future limitation of contact with low Btu tar/sludge through site controls and land use restrictions and for minimizing potential risks associated with VOC emissions via water covers. Each of these measures is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents to the soil and ground water remain since the low Btu value tar/sludge would remain in-place within the impoundments. These components, therefore, would not provide long-term effectiveness for Alternative B1. Alternatives B2, B3, B4, and B5 would provide long-term effectiveness by minimizing residual risk through removal, solidification for strength and reduction of metals leachability, and containment of the low Btu tar/sludge in the Impound 8 facility. Each of these measures is an adequate and reliable method for minimizing human exposure and minimizing migration of the tars constituents. Alternatives B3, B4, and B5 would further minimize human exposure and enhance long-term effectiveness through treatment with Alternative B5 providing increased long-term effectiveness with the highest degree of contaminant removal through incineration. Alternatives B3, B4 and B5 would permanently reduce the levels of contaminants that are present in the impoundment material.

Reduction of toxicity, mobility, or volume through treatment. Alternative B1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternative B2 (consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in Impound 8. A slight volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternatives B3 and B4 (bioremediation and LTTT) offer a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. Alternative B3 would have a net material volume increase of approximately 200% due to required pre- and post-conditioning. A net material volume increase of 25% is expected for Alternative B4 due to pre-LTTT conditioning and post-LTTT conditioning with admixtures. Alternative B5 (incineration) offers the greatest reduction in contaminant mass and toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net material volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative B5 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through incineration. Alternatives B3, B4, and B5 would permanently reduce the levels of contaminants that are present in the impoundment material.

Short-term effectiveness. In each alternative, the community would be restricted from access to the site during remediation through locking gates currently in-place and an existing manned guardpost. Alternative B1, no action/institutional actions, would provide for limitation of contact with the low Btu tar/sludge through site controls and land use restrictions. The water covers at Impoundments 4, 5 and 14 would also limit contact with the material by limiting VOC emissions from those impoundments. There would be no anticipated impacts to the community from ground water monitoring associated with this alternative. Appropriate protective equipment would be used during monitoring activities in Alternative B1 and in remedial activities in Alternatives B2, B3, and B4. Appropriate mitigation measures would be implemented to control vapor emissions during excavation and treatment of the low Btu tar/sludge in Alternatives B2, B3, and B4. With respect to Alternatives B2, B3, and B4, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts. The use of appropriate controls would therefore provide for equivalent short-term effectiveness with respect to human health in each alternative. Alternatives B2, B3, B4 and B5 would provide for equivalent short-term effectiveness with respect to the environment with appropriate controls, while environmental impacts would not be minimized in Alternative B1 since migration of constituents to the ground water would continue for the in-place material.

With respect to the RAO, Alternative B1 would not provide for minimization of migration of constituents to the air, soil, or ground water. Alternatives B2, B3, B4, and B5 would achieve the RAO upon completion. Alternative B2 would achieve the RAO in a timeframe of 1 to 2 yrs.

Alternative B3 would achieve the RAO in a timeframe of approximately 5 to 7 yr. Alternative B4 would achieve the RAO in an approximate 3 to 4 yr timeframe, and Alternative B5 would achieve the RAO in an approximate 4 to 5 yr timeframe. Alternatives B2, B3, B4, and B5 would provide protection of human health and the environment, limit construction worker contact with the low Btu tar/sludge material, and avoid activities which could cause the mobilization of contaminants. Alternative B1would not attain RAOs, but it can be implemented immediately. Of the remaining alternatives, Alternative B2 is better than Alternative B3, B4, and B5 because it can achieve the RAOs in a shorter timeframe than these alternatives.

Implementability. Alternatives B1 and B2 are readily implementable. Alternatives B3 and B4 are also implementable based upon results of the 1995 and 1996 bioremediation treatability study and the 1995 and 1996 LTTT treatability study, respectively (Appendices A and B). Bioremediation is a natural, lower energy, and less intensive remedial technology than LTTT. It does not require the extent of mobilization, processing equipment or air pollution control as does LTTT. Alternative B5 is considered to be moderately implementable with the same requirements as B4. Coordination with the NJDEP would be required for implementation of air controls associated with Alternatives B2, B3, B4 and B5. Coordination with the NJDEP and Army Corps of Engineers would be required to backfill in a floodplain and wetland area for Alternatives B2, B3, B4 and B5. The technologies presented in Alternatives B3, B4, and B5 are considered to be reliable and effective at meeting the Group III treatment objectives. Impound 8 is anticipated to be available to receive treated residuals from Alternatives, B2, B3, B4, and B5. Alternative B1 is most readily implementable. Of the remaining alternatives which attain RAOs, Alternative B2 is most implementable.

Cost. Capital costs for each alternative were estimated. O&M and total present worth costs were estimated for Alternative B1. For Alternatives B2, B3, B4, and B5. O&M costs associated with the overall O&M of the Impound 8 facility were not included. Overall, Alternative B1 was the least expensive alternative, followed by B2, B3, B4, and B5, respectively. A cost comparison of alternatives is presented as follows:

Alternative	Capital	O&M	30-Yr Present Worth
B1 (No action/institutional actions)	$3,600	$14,000	$180,000
B2 (Consolidation in Impound 8)	$14,000,000	N/A	$14,000,000

Alternative	Capital	O&M	30-Yr Present Worth
B3 (Bioremediation)	$33,000,000	N/A	$33,000,000
B4 (LTTT)	$41,000,000	N/A	$41,000,000
B5 (On-site Incineration)	$66,000,000	N/A	$66,000,000

USEPA acceptance. Regulatory agency acceptance will be documented in the ROD.

Community acceptance. Community and local government are opposed to on-site incineration.

8.4. Category C: Impoundment 3

8.4.1. Individual analysis of alternatives

The remedial alternatives which are being evaluated for Impoundment 3 include:

- Alternative C1- no action/institutional actions
- Alternative C2 - consolidation in Impound 8
- Alternative C3 - LTTT
- Alternative C4 - on-site incineration.

The individual analysis of alternatives for Impoundment 3 with respect to the nine evaluation criteria is documented in Table 8-12. Detailed cost estimates for Alternatives C1, C2, C3 and C4 are presented in Tables 8-13, 8-14, 8-15, and 8-16. For Alternatives C2, C3 and C4, O&M costs associated with overall O&M of the Impound 8 facility were not included in the alternative cost estimates as they were deemed comparable for each alternative.

8.4.2. Comparative analysis of alternatives

Overall protection of human health and the environment. Alternative C1 would not provide overall protection of human heath and the environment, while Alternatives C2, C3, and C4, would provide equivalent protection through removal and containment in Impound 8. Alternatives C2, C3 and C4 would minimize human exposure to the Impoundment 3 material and minimize constituent migration through containment of the material in Impound 8. Alternatives C3 and C4 would provide an increased level of protection through treatment of the Impoundment 3 material, with

Alternative C4 providing the highest level of overall protection of human health and the environment with the highest degree of contaminant removal through incineration.

Compliance with ARARs. There are no chemical-specific ARARs associated with Alternative C1. UTSs specified in EPA's LDRs are chemical-specific ARARs for Alternatives C2, C3, and C4 as the material would be removed from the impoundments and disposed in Impound 8. There are three possible ways to comply with this requirement: 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels), or 3) granting a CAMU and developing alternative treatment standards. For Alternative C2, the third option associated with alternative treatment standards under a CAMU is the only way to meet this ARAR based on raw material characterization. It is expected that LTTT in Alternative C3 would not achieve UTSs or treatability variance levels using the 6A guidance levels. Therefore, option 3 is also the only way for Alternative C3 to meet the ARAR. Alternative C4, on-site incineration, would be expected to meet either option 1 or option 2 through destruction of the organic material. Alternatives C2, C3, and C4 would each meet the chemical-specific ARAR.

The New Jersey Flood Hazardous Control Act Regulations (NJAC 7:13 et. seq.) would be a location-specific ARAR for each of the alternatives. This ARAR would be met through specifying the substantive floodplain requirements in the remedial action contract and by maintaining compliance through remedial action monitoring. In addition, the New Jersey Standards for New Hazardous Waste Facilities (NJAC 7:26-10.3) would be another location-specific ARAR for Alternatives C2, C3, and C4 as placement of the materials would be in Impound 8. This ARAR would be met for these alternatives by specifying the substantive requirements in the remedial action contract and by maintaining compliance with those requirements through remedial action monitoring. Each alternative would meet the location-specific ARARs.

Action-specific ARARs identified for Alternatives C1, C2, C3, and C4include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARs would be met through specifying the substantive requirements in the remedial action contract and by monitoring compliance during inspection activities. Additional action-specific ARARs would be triggered for Alternatives C2, C3, and C4 due to material excavation, conditioning and/or treatment, and placement in Impound 8. These ARARs would include New Jersey SESC requirements; New Jersey Hazardous waste regulations related to residual waste disposal; DOT transport requirements; and RCRA regulations pertaining to Impound 8. These ARARs would also be meet through specification of the substantive requirements in the remedial action contract documents and during remedial action monitoring to maintain compliance. Each alternative would meet the action-specific ARARs.

Long-term effectiveness and permanence. Alternative C1 would provide for future limitation of contact with Impoundment 3 materials through site controls and land use restrictions Each of these is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents to the ground water remain since the material would remain in-place within Impoundment 3. These components, therefore, would not provide long-term effectiveness. Alternatives C2, C3, and C4, would provide long-term effectiveness by minimizing residual risk through removal, solidification for strength and reduction of metals leachability, and containment of the Impoundment 3 material in Impound 8. Each of these measures is an adequate and reliable method for minimizing human exposure and minimizing migration of the Impoundment 3 constituents and would provide long-term effectiveness. Alternatives C3 and C4 would further minimize human exposure and enhance long-term effectiveness through treatment with Alternative C4 providing increased long-term effectiveness with the highest degree of contaminant removal through incineration.. Alternatives C3 and C4 would permanently reduce the levels of contaminants that are present in the impoundment material.

Reduction of toxicity, mobility, or volume through treatment. Alternative C1 does not include any removal or treatment; and therefore, offers no reduction of toxicity, mobility, or volume. Alternative C2 would provide for a reduction in mobility through solidification and placement in Impound 8. A slight material volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternative C3 offers a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction of mobility is provided through placement in Impound 8. Alternative C3 would result in approximately 30% net material volume increase due to pre-LTTT and post-LTTT conditioning with admixtures. Alternative C4 offers the greatest reduction in contaminant mass and toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net material volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative C4 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through incineration. Alternatives C3 and C4 would permanently reduce the levels of contaminants that are present in the impoundment material.

Short-term effectiveness. Alternative C1 would provide for limitation of contact with the Impoundment 3 material through site controls and land use restrictions. There would be no anticipated impacts to the community from ground water monitoring associated with this alternative. In Alternatives C2, C3 and C4 the community would be restricted from access to the site during remediation through locking gates currently in-place and an existing manned guard station. Appropriate protective equipment would be used during monitoring activities in Alternative C1 and in remedial activities in Alternatives C2, C3 and C4. Appropriate mitigation measures would be implemented to control vapor emissions during excavation and treatment of the Impoundment 3 material in Alternatives C2, C3 and C4. With respect to Alternatives C2, C3 and C4, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts. The use of appropriate controls would therefore provide for equivalent short-term effectiveness with respect to human health in each alternative. Alternatives C2, C3, and C4 would provide for equivalent short-term effectiveness with respect to the environment, while environmental impacts would not be minimized in Alternative C1 since migration of constituents to the ground water would continue for the in-place material.

With respect to the RAO, Alternative C1 would not provide for minimization of migration of constituents. Alternatives C2, C3 and C4 would achieve the RAO upon completion. Alternative C2 would achieve the RAO in 1 yr. Alternative C3 would achieve the RAO in approximately 1 to 2 yr. Alternative C4 would achieve the RAO in an approximate 1 to 3 yr timeframe. Alternatives C2, C3 and C4 would provide protection of human health and the environment, limit construction worker contact with Impoundment 3 material, and avoid activities which could cause the mobilization of contaminants. Alternative C1 would therefore not attain RAOs, but it can be implemented immediately. Of the remaining alternatives, Alternative C2 is better than Alternatives C3 and C4 because it can achieve the RAOs in a shorter timeframe than these alternatives.

Implementability. Alternatives C1 and C2 are readily implementable. Alternative C3 is also readily implementable based upon results of 1995 and 1996 LTTT pilot study results (Appendix A). Pretreatment via TEMD in Alternative C3 is also considered to be readily implementable based on the results of that pilot test. Alternative C4, is considered to be moderately implementable with the same requirements as C3. Coordination with the NJDEP would be required for implementation of air controls associated with treatment technologies and conducting remedial actions for Alternatives C2, C3, and C4. The technologies presented in Alternatives C3 (including TEMD) and C4 are considered to be reliable and effective at meeting the Group III treatment objectives. Impound 8 is considered to be readily available to receive treated materials from Alternatives C2, C3 and C4. Alternative C1 is most readily implementable. Of the remaining alternatives which meet RAOs, Alternative C2 is most implementable.

Cost. Capital costs for each alternative were estimated. O&M and total present worth costs were estimated for Alternative C1. For Alternatives C2, C3 and C4, costs associated with the overall O&M of the Impound 8 facility were not included. Alternative C1 is the least expensive alternative, followed by C2, C3, and C4, respectively.

A cost comparison of alternatives is presented as follows:

Alternative	Capital	O&M	30-Yr Present Worth
C1 (No action/institutional actions)	$3,600	$14,000	$170,000
C2 (Consolidation in Impound 8)	$3,000,000	N/A	$3,000,000
C3 (LTTT)	$10,000,000	N/A	$10,000,000
C4 (On-site Incineration)	$14,800,000	N/A	$14,800,000

USEPA acceptance. Regulatory agency acceptance will be documented in the ROD.

Community acceptance. Community and local government are opposed to on-site incineration.

8.5. Category D: Non-hazardous material

8.5.1. Individual analysis of alternatives

The remedial alternatives which are being evaluated for the non-hazardous material include:

- Alternative D1 - no action/institutional controls
- Alternative D2 - bioremediation with final placement in Impound 8
- Alternative D3 - off-site disposal
- Alternative D4 - consolidation in Impound 8.

The individual analysis of alternatives for Category D: Non-hazardous material with respect to the nine evaluation criteria is documented in Table 8-17. Detailed cost estimates for each of the above alternatives is provided in Tables 8-18 - 8-21. For Alternatives D2 and D4, O&M costs associated with the Impound 8 facility were not included in the alternative cost estimates.

8.5.2. Comparative analysis of alternatives

Overall protection of human health and the environment. Alternative D1 would not provide overall protection of human health and the environment, while Alternatives D2, D3, and D4 would provide equivalent protection through containment in Impound 8 or an off-site landfill. Alternative D2 would minimize human exposure to the material constituents and minimize migration to environmental media through removal, bioremediation and containment of the material in Impound 8. Alternatives D3 and D4 would also minimize human exposure and migration to environmental media through removal and containment of the material at either an off-site disposal facility or on-site at Impound 8. Alternative D2 would provide the highest level of overall protection of human health and the environment with treatment prior to containment.

Compliance with ARARs. As described in Section 7, no chemical-specific ARARs were identified for the 4 alternatives. No location-specific ARARs have been identified for Alternative D1. Alternative D2, D3, and D4 would be subject to New Jersey Flood Hazard Control Act Regulations (NJAC &:13-1 et. seq.). This ARAR would be met by having on-site work conducted in floodplain areas consistent with substantive permit regulations. Alternative D2, D3, and D4 would meet the location-specific ARARs.

Action-specific ARARs identified for Alternative D1 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARs would be met by specifying and monitoring activities so that they are conducted in accordance with the ACO, NJAC 7:26E et. seq. and OSHA. These requirements, as well as New Jersey SESC requirements; DOT transport requirements; and New Jersey air control regulations, are potentially applicable action-specific ARARs for Alternatives D2, D3, and D4. These ARARs, as applicable, would be met by specifying and monitoring activities so that they are in compliance with the substantive requirements of these regulatory programs. Each alternative would meet the action-specific ARARs.

Long-term effectiveness and permanence. Alternative D1 would provide for future limitations of contact with non-hazardous material through site controls and land use restrictions. Each of these measures is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents remain since the material would remain in-place. These components, therefore, would not provide long-term effectiveness for Alternative D1. Alternatives D2, D3, and D4 would minimize residual risk through removal, solidification for strength and reduction of metals leachability, and containment. Alternatives D2, D3, and D4 are adequate and reliable methods for minimizing human exposure, minimizing migration of the constituents, and would provide long-term effectiveness, with Alternative D2 providing, increased long-term effectiveness with the highest degree of contaminant removal through bioremediation. Alternative D2 would permanently reduce the levels of contaminants that are present in the impoundment material.

Reduction of toxicity, mobility, or volume through treatment. Alternative D1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternatives D3 and D4 (off-site disposal and consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in an off-site landfill or Impound 8. A slight material volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternative D2 (bioremediation) offers a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. Alternative D2 would have a net material volume increase of approximately 200% for Impoundment 5 material and 100% for Impoundment 26 material due to required pre- and post-conditioning. Alternative D2 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through bioremediation. Alternative D2 would permanently reduce the levels of contaminants that are present in the impoundment material.

Short-term effectiveness. Alternative D1 would provide for limitations of contact with the non-hazardous material through site controls and land use restrictions. There would be no anticipated impacts to the community from ground water and tar seep monitoring associated with this alternative. In Alternatives D2, D3, and D4, the community would be restricted from access to the site during remedial activities through locking gates currently in-place and an existing manned guardpost. Appropriate protective equipment would be used during monitoring activities in Alternative D1 and in remedial activities for Alternatives D2, D3, and D4. Appropriate mitigation measures would be implemented to control vapor emissions during excavation of the non-hazardous material in Alternatives D2, D3, and D4. With respect to Alternatives D2, D3, and D4, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts. The use of appropriate controls would threfore provide an equivalent level of short-term effectiveness with respect to human health in each alternative. Alternatives D2, D3, and D4 would provide for equivalent short-term effectiveness with respect to the environment with appropriate controls while, environmental impacts would not be minimized in Alternative D1, since migration of constituents to the ground water could continue of the in-place material.

With respect to the RAO, Alternative D1 would not provide for minimization of constituents. Alternative D2 would achieve the RAO upon completion of construction activities within approximately 2 to 3 yr. Alternatives D3 and D4 would achieve the RAO upon completion of construction activities within approximately 1 to 2 yr. Alternative D1 would therefore not attain RAOs, but it can be implemented immediately. Of the remaining alternatives, Alternatives D3 and D4 are better than alternative D2 because they can achieve the RAOs in a shorter timeframe.

Implementability. Components of Alternative D1, including land use restrictions, ground water monitoring, and tar seep monitoring, are readily implementable and reliable for their intended functions. Alternative D2 and D4 are also readily implementable based upon the availability of Impound 8. Alternative D3 is readily implementable assuming that the characterization of the material is acceptable to the off-site disposal facility with no further treatment. Coordination with the NJDEP would be required for implementation of air pollution controls associated with materials conditioning for Alternatives D2, D3, and D4. Alternative D2 would also require air pollution controls during active treatment. Alternative D1 is most readily implementable. Of the remaining alternatives which attain RAOs, Alternative D4 is most implementable.

Cost. Capital costs for each alternative were estimated. O&M and total present work costs were estimated for Alternative D1. For Alternatives D2 and D4, costs associated with the overall O&M of Impound 8 were not included. Similarly, costs associated with O&M of an off-site disposal facility were also not included. Alternative D1 is the least expensive alternative, followed by D4, D3, and D2, respectively.

A cost comparison of alternatives is as follows:

Alternate	Capital	O&M	30-yr Present Worth
D1 (No Action/Institutional Controls)	$3,600	$14,000	$170,000
D2 (Bioremediation)	$17,000,000	N/A	$17,000,000
D3 (Off-site disposal)	$10,000,000	N/A	$10,000,000
D4 (Consolidation into Impound 8)	$1,800,000	N/A	$1,800,000

USEPA acceptance. Regulatory agency acceptance will be documented in the ROD.

Community acceptance. Community acceptance will be documented in the ROD following public comment on the proposed plan.

8.6. Category E: General plant debris

8.6.1. Individual analysis of alternatives

The remedial alternatives which are being evaluated for the general plant debris include:

- Alternative E1- no action
- Alternative E2 - consolidation into Impound 8.

The individual analysis of alternatives for general plant debris with respect to the nine evaluation criteria is documented in Table 8-20. A detailed cost estimate was not developed for Alternative E1 because institutional action costs for general plant debris were accounted for within the no action/institutional actions alternative cost estimates for the lower Btu value tar, Impoundment 3, and non-hazardous fill. The detailed cost estimate for Alternative E2 is presented in Table 8-21. For Alternative E2, costs associated with overall O&M of the Impound 8 facility were not included in the alternative cost estimates.

8.6.2. Comparative analysis of alternatives

Overall protection of human health and the environment. Alternative E1, is not protective based on residual sludge that may be present. Alternative E2 would be protective of human health and the environment.

Compliance with ARARs. As described in Section 7, no chemical specific ARARs were identified for Alternatives E1 and E2.

No location-specific ARARs have been identified for Alternative E1. The New Jersey Flood Hazard Control Act Regulations (NJAC 7:13-1 et. seq) would be a location-specific ARAR associated with Alternative E2. On-site work conducted in floodplain areas would need to be consistent with substantive permit requirements.

Alternative E1, would not meet New Jersey Solid and Hazardous Waste Regulations which prohibit creation of waste piles (the debris would have residual sludge present). Action-specific ARARs identified for Alternative E2 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations, as well as New

Jersey SESC requirements and DOT transport requirements. Remedial actions comprising Alternative E2 would be conducted in accordance with these action-specific ARARs. Alternatives E1 and E2 would both attain action-specific ARARs.

Long-term effectiveness and permanence. Alternative E1, no action, can only occur if Alternatives A1, B1, and C1 are implemented. Alternate E1 would provide for future limitation of contact through site controls and land use restrictions. Each of these is an adequate and reliable control for limiting human contact. The potential risks associated with migration of constituents of residual sludge, is addressed in Alternatives A1, B1, and C1. Alternative E1, would provide for long-term effectiveness for the debris only. Alternative E2 would provide minimal residual risk through removal and containment of the general plant debris in the Impound 8 facility. Alternative E2 would also provide long-term effectiveness.

Reduction of toxicity, mobility, or volume through treatment. Alternative E1 does not include active treatment technologies; therefore, reduction of toxicity, mobility, or volume of the general plant debris material through treatment is not applicable. Mechanical separation of surface debris from the sludge material is considered beneficial as a best management practice consistent with EPA guidance. Alternative E2 will provide for minimization of mobility of constituents through containment in Impound 8.

Short-term effectiveness. There would be no anticipated impacts to the community from Alternative E1. In Alternative E2, the community would be restricted from access to the site during excavation and handling activities through locking gates currently in-place and an existing manned guardpost. Appropriate protective equipment would be used during excavation activities in Alternative E2. There are no anticipated environmental impacts associated with Alternatives E1 and E2. With respect to the RAO, general plant debris is not addressed.

Implementability. Alternative E1 involves no implementation. Alternative E2 is readily implementable based upon the availability of Impound 8.

Cost. There are no costs associated with Alternative E1. Capital costs for Alternative E2 were estimated. For Alternative E2, costs associated with the overall O&M of the Impound 8 facility were not included.

A cost summary of alternatives is presented as follows:

Alternative	Capital	O&M	30-Yr Present Worth
E1 (No action)	N/A	N/A	N/A
E2 (Consolidation into Impound 8)	$800,000	$0	$800,000

USEPA acceptance. Regulatory agency acceptance will be documented in the ROD.

Community acceptance. Community acceptance will be documented in the ROD following public comment on the proposed plan.

9. Recommended alternatives and proposed schedule

9.1. Introduction

A wide range of remedial alternatives for the Group III Impoundments was evaluated in the previous sections in accordance with the requirements of the NCP, CERCLA/SARA, and the 1988 ACO, as amended, between the NJDEP and American Cyanamid. The 1988 ACO, as amended, also provides an opportunity to recommend one of the remedial alternatives for consideration by the agencies. This section defines that alternative. The remedy must be consistent with the regulatory goals of cleaning up the site, meeting the ARARs, implementing a timely cleanup, and protecting human health and the environment.

Three points should be considered in selecting remedies for these impoundments. First, the treatability studies and the NCP evaluation criteria assessment demonstrated that several remedial alternatives would achieve comparable levels of success. In accordance with CERCLA, if two or more options achieve the remedial objectives and satisfy the regulatory requirements, and there is a significant differential in cost, then the less costly remedy is acceptable. Second, when considered in the context of the entire site, the Group III impoundments represent the most complex material types, the highest concentrations of organic constituents, and the most difficult material to handle. Therefore, the recommended remedy must address material handling, material types, and preconditioning issues. Finally, the remedies must be protective of human health and the environment and satisfy the ARARs.

9.2. Recommended alternatives

The recommended Group III alternatives have been developed based on material category and are summarized as follows:

Category	Description	Recommended Alternative
A	High Btu tar	LTTT
B	Low Btu tar/sludge	Bioremediation
C	Impoundment 3 material	LTTT

Category	Description	Recommended Alternative
D	Non-hazardous material	Consolidation in Impound 8
E	General plant debris	Consolidation in Impound 8

This alternative meets the objectives of the three points discussed above:

- It is one of the alternatives that achieves the remedial objectives by satisfying the ARARs protecting human health and the environment
- The remedy has been proven to be implementable at a bench-scale and pilot-scale level
- It is the most cost-effective when compared to other alternatives that achieve comparable levels of protection for the respective category.

The recommended alternative involves:

High Btu tar (Impoundments 1 and 2). Excavate the impoundment contents; pre-condition with additives; perform LTTT; post-condition to meet physical disposal criteria; consolidate into the Impound 8 facility.

In addition to the sludges within these impoundments, Cyanamid proposes to remove, treat and dispose of the soils underlying these impoundments that exist above ground water. These soils exhibit similar characteristics as the overlying sludge. By removing these soils, final site restoration can occur as part of the remedial action. Residual compounds present in the ground water would be addressed as part of the site-wide ground water program.

Low Btu tar (Impoundments 4, 5 (wet), 14, and 20). Excavate the impoundment contents; separate the oversized materials; reduce the size of the remaining material, as needed, to allow for processing; precondition and use solid phase bioremediation to treat the materials; solidify the treated residuals (as necessary for strength) and consolidate the treated residuals into the Impound 8 facility.

Impoundment 3 material. Excavate the impoundment contents; pre-condition with additives; perform LTTT; post-condition to meet physical disposal criteria; consolidate into the Impound 8 facility.

Non-hazardous material. Excavate; separate and clean the oversized materials; consolidate into the Impound 8 facility.

General plant debris. Separate from other impoundment material; separate residual surface sludge for treatment, size as appropriate for consolidation into the Impound 8 facility.

These alternatives reflect a balance between treating the contents of the impoundments that contain hazardous material to achievable, risk-supported treatment objectives prior to consolidation in Impound 8, and consolidating without treatment the non-hazardous material. The characterization and pilot studies demonstrated that Impoundments 1, 2, 3, 4, 5 (wet), 14, and 20 contain elevated concentrations of hazardous constituents which represent a continuing source of ground-water contamination. In contrast, Impoundments 5 (dry) and 26 contain "landfill-like" materials, are non-hazardous, and have sufficient bearing strength "as is" based on the solidification bench-scale test results. Thus, the recommended remedy reflects a balance between removing and treating certain impoundment materials to prevent future adverse impacts to ground water, and removing other material that are not classified as a characteristic hazardous waste. Both components make use of the on-site Impound 8 facility to consolidate the treated and untreated materials. This added layer of protection is fundamental to the permanence of this remedy.

9.3 Justification for the recommended alternatives

The following reasons provide the basis for selecting the recommended alternatives:

- Bioremediation would be effective in reducing the compounds of concern for material category B
- The site is suited to bioremediation (for category B) because the existing bacteria are already acclimated to the waste materials, and have been shown in the laboratory and during the pilot study to satisfactorily degrade the compounds of concern
- LTTT and bioremediation combination provide flexibility in remediating the wide variety of heterogeneous material within the Group III impoundments
- LTTT will be used to achieve Group III treatment objectives for materials that are not amenable to bioremediation
- The combination of bioremediation and LTTT is more cost-effective, yet provides a comparable level of protection.

Final disposition of all material will be in Impound 8, a permitted, triple-lined waste management facility.

9.4. Impound 8 contingencies

A contingency plan is proposed in the event that contaminants and/or leakage is detected below the secondary liner system of Impound 8. The plan will include monitoring of the subsurface drainage system, which is located beneath the tertiary liner, in the event that leachate is present within the leachate detection system at levels greater than the Action Leakage Rate specified in the regulations. The existing Impound 8 Preparedness and Prevention Plan, and Program Contingency Plan will be modified to include the proposed components. In the event that leachate is detected beneath the tertiary liner, a ground water containment/collection program will be implemented. This program would include the installation of a ground water extraction system at the Impound 8 facility. Plans and sections of the Impound 8 facility are shown in Figure 9-1.

9.5. Schedule

The proposed schedule for implementing the recommended alternative is illustrated in Figure 9-2. This schedule has been developed with the understanding that site-wide implementation of multiple investigatory and remedial activities is ongoing. The extent of remedial efforts underway at the site, and the logistics of completing certain activities prior to initiation of other activities, require careful scheduling considerations. The proposed schedule differs from previous schedules submitted to the agencies in that it is presented on a quarterly basis and, more importantly, that it shows the importance of coordinating the Group III remedial activities with the Impound 8 facility program and those portions of the Groups I and II remedial activities which may impact Group III work, and vice-versa. The components presented in Figure 9-2 reflect a schedule based on current projections. A more precise schedule for remediation of the Group III Impoundments will be provided in the Remedial Design Report for these impoundments.

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Table 2-1. *Group III CMS/FS Impoundment material categorization*

Category	Material	Description	Impound	Vol. (yd^3)	Total (yd^3)	Area (Acre)	Historical Use[2]	Other[2]
A	High BTU Tar	The high BTU value tar consists of the upper and lower layers of material in Impoundments 1 and 2.	1	19,500	43,500	2.1	Used for the storage of tars and process sludge resulting from the coal oil refining process	Sulfur(%) 4.15-6.88 Btu Content (Btu/lb) 7,200 pH 0.5-1 Density (lb/gal) 9.8-10.1 Moisture (%) 25-45
			2	24,000		2.3	Used for the storage of tars and process sludge resulting from the coal oil refining process	Sulfur(%) 6.63-7.93 Btu Content (Btu/lb) 10,000 pH 0.5-1 Density (lb/gal) 9.2-9.6 Moisture (%) 25-45
B	Low Btu Tar/ Sludge	The tar material consists of organic tar that is typically stringy and viscous.	4	900	87,700	1	Used for the storage of organic tars from the various production processes at the Bound Brook facility.	Sulfur (%) 6.87-9.15 Btu Content (Btu/lb)[3] 1,994 Density (lb/gal) 9.05
			5	75,000		5	Originally used for the storage of sludges from manufacturing activities on-site, specifically from the manufacture of rubber chemicals. Subsequently used for the disposal of material organic tars.	Sulfur (%) 5-7.65 Btu Content (Btu/lb)[3] 819-15,268 Density (lb/gal) 8.64-10.89
			14	4,000		0.9	Used for storage of organic tars and subsequently used to dispose of sludges and general plant debris.	Sulfur (%) 2.03 Btu Content (Btu/lb) 7,192 Density (lb/gal) 9.56-10.89
			20	7,800		1	Used as a settling basin for the pretreatment of wastewater generated from the dye and pigment operation.	NA[1]

Table 2-1. *Group III CMS/FS Impoundment material categorization*

Category	Material	Description	Impound	Vol. (yd^3)	Total (yd^3)	Area (Acre)	Historical Use[2]	Other[2]
C	Impound 3	Tar material that consists of organic tar, and fill material that consists of dry "soil" other than the general plant materials.	3	16,800	16,800	1.3	Originally used for the storage of organic tars from the distillation of coal oil and subsequently filled with soil, construction debris, and general plant material	Some of the plant materials which were disposed in Impoundment 3 originated form the dye/pigments operations.
D	Non-hazardous Material	The non-hazardous material consists of tars and fill material in Impoundments 5 and 26.	5	29,800	47,400	2.7	Originally used for the storage of sludges from manufacturing activities on-site, and subsequently for the disposal of organic tars. In the 1960's and 1970's filling of the impoundment with soil, general plant debris, drums, and some construction debris was conducted from the western berm.	NA[1]
			26	17,600		1.3	Impoundment 26 was used for the storage of organic tars generated form the production processes at the Bound Brook facility and subsequently, filled with construction debris, general plant material, and fill.	Sulfur (%) 0.35-9.25 Btu Content (Btu/lb) 8,516 Density (lb/gal) 9.18-10.89

Table 2-1. *Group III CMS/FS Impoundment material categorization*

Category	Material	Description	Impound	Vol. (yd^3)	Total (yd^3)	Area (Acre)	Historical Use[2]	Other[2]
E	General Plant Debris	General plant debris consist of various demolition materials (wood, concrete, and steel), whole and crushed steel drums, cloth, glass. This material is generally large in size and inert. No chemical characterization was completed on this material.	3 4 5 14 26	4,200 100 5,500 1,000 4,400	15,200	NA[1]	NA[1]	NA[1]
TOTAL					210,600 yd^3			

Notes:

(1) NA = Not Available/Not Applicable

(2) Information obtained from *Lagoon Characterization Report,* OBG, April 1983, *Impoundment Characterization Program Final Report,* BB&L, August 1990, *Group II CMS/FS Report,* BB&L, November 1994, and *Group III CMS/FS Report*, BB&L, May 1995.

(3) Btu content prior to Lagoon 4/5 fuel blending program.

Table 7-1. *Potential alternative-specific chemical, action and location specific ARARs*

Potential ARARs	A1	A2	A3	A4	B1	B2	B3	B4	B5	C1	C2	C3	C4	D1	D2	D3	D4	E1	E2
CHEMICAL-SPECIFIC ARARs																			
USEPA Land Disposal Restrictions (40 CFR 268)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						
LOCATION-SPECIFIC ARARs																			
Floodplains																			
New Jersey Flood Hazard Control Act Regulations (NJAC 7:13-1 et. seq.)	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓
New Jersey Location Standards for New Hazardous Waste Facilities (NJAC 7:26-10.3)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						
Wetlands																			
New Jersey Freshwater Wetlands Protection Act (NJAC 7:7A-1 et. seq.)						✓	✓	✓	✓										
Clean Water Act Section 404 and Nationwide Permit Program (33 CFR 330)						✓	✓	✓	✓										
ACTION-SPECIFIC ARARs																			
General Site Remediation Activities																			
1988 ACO (amended May 4, 1994)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stream Encorachment		✓	✓	✓															
Cultural Resources		✓	✓	✓															

Notes:
A1 = No action/institutional actions
A2 = Consolidation into Impound 8
A3 = LTTT
A4 = Incineration

B1 = No action/institutional actions
B2 = Consolidation into Impound 8
B3 = Bioremediation
B4 = LTTT
B5 = Incineration

C1 = No action/institutional actions
C2 = Consolidation into Impound 8
C3 = LTTT
C4 = Incineration

D1 = No action/institutional actions
D2 = Bioremediation
D3 = Off-site disposal
D4 = Consolidation into Impound 8

E1 = No action/institutional actions
E2 = Consolidation into Impound 8

Table 7-1. *Potential alternative-specific chemical, action and location specific ARARs*

Potential ARARs	A1	A2	A3	A4	B1	B2	B3	B4	B5	C1	C2	C3	C4	D1	D2	D3	D4	E1	E2
New Jersey Soil Erosion and Sediment Control Act Requirements (NJAC 4:24-42 and NJAC 2:90-1.1 et. seq.)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓
OSHA - General Industry Standards - Hazardous Waste Operations and Emergency Responses (29 CFR Part 1910.120)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OSHA - Safety and Health Standards - Construction Industry Standards (29 CFR Part 1926)	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓
OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR Part 1904)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hazardous Waste Management Activities																			
New Jersey Solid and Hazardous Waste Regulations (NJAC 7:26-1, 7, 8, 9, 11)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						
USEPA Land Disposal Restrictions (40 CFR 268)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						
Air Emission Activities																			
New Jersey Air Pollution Control Regulations (NJAC 7:27 et. al.)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		
National Ambient Air Quality Standards (40 CFR Part 50)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		
Transportation Activities																			
New Jersey Solid and Hazardous Waste Transportation Regulations (NJAC 7:26-3)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓

Notes:

A1 = No action/institutional actions
A2 = Consolidation into Impound 8
A3 = LTTT
A4 = Incineration

B1 = No action/institutional actions
B2 = Consolidation into Impound 8
B3 = Bioremediation
B4 = LTTT
B5 = Incineration

C1 = No action/institutional actions
C2 = Consolidation into Impound 8
C3 = LTTT
C4 = Incineration

D1 = No action/institutional actions
D2 = Bioremediation
D3 = Off-site disposal
D4 = Consolidation into Impound 8

E1 = No action/institutional actions
E2 = Consolidation into Impound 8

Table 7-1. *Potential alternative-specific chemical, action and location specific ARARs*

Potential ARARs	A1	A2	A3	A4	B1	B2	B3	B4	B5	C1	C2	C3	C4	D1	D2	D3	D4	E1	E2
New Jersey Hazardous Waste Transporter Responsibilities (NJAC 7:26-7.5)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						
Department of Transportation (DOT) Rules for Hazardous Materials Transport (49 CFR 172, 173, 177, and 178)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓
Disposal Activities																			
RCRA CAMU Regulations (40 CFR Part 264.552)		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓						

Notes:

A1 = No action/institutional actions
A2 = Consolidation into Impound 8
A3 = LTTT
A4 = Incineration

B1 = No action/institutional actions
B2 = Consolidation into Impound 8
B3 = Bioremediation
B4 = LTTT
B5 = Incineration

C1 = No action/institutional actions
C2 = Consolidation into Impound 8
C3 = LTTT
C4 = Incineration

D1 = No action/institutional actions
D2 = Bioremediation
D3 = Off-site disposal
D4 = Consolidation into Impound 8

E1 = No action/institutional actions
E2 = Consolidation into Impound 8

Table 8-1. *Detailed Analysis of Alternatives - Category A: High Btu tar*

	Alternative A1 **No Action/Institutional Actions**	**Alternative A2** **Consolidation in Impound 8**	**Alternative A3** **LTTT**	**Alternative A4** **On-Site Incineration**
	OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT			
Protection of Human Health	Institutional actions would provide a slight increase in the level of protection from human exposure.	Containment in Impound 8 would minimize human exposure to high Btu tar material.	Removal, LTTT, and containment in Impound 8 would minimize human exposure to high Btu tar material.	Removal, incineration, and containment in Impound 8 would minimize human exposure to high Btu tar material.
Protection of Environment	The potential for high Btu tar constituent migration would remain.	Removal of high Btu tar would minimize constituent migration to environmental media.	Removal of high Btu tar would minimize constituent migration to environmental media.	Removal of high Btu tar would minimize constituent migration to environmental media.
	COMPLIANCE WITH ARARS			
Chemical-specific ARARs	None identified	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be achieved with incineration, or by obtaining a treatability variance.
Location-specific ARARs	Installation of fencing would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.

Table 8-1. ***Detailed Analysis of Alternatives - Category A: High Btu tar***

	Alternative A1 No Action/Institutional Actions	**Alternative A2 Consolidation in Impound 8**	**Alternative A3 LTTT**	**Alternative A4 On-Site Incineration**
Action-specific ARARs	Fencing and monitoring activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, and OSHA requirements.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, NJ Soil Erosion and Sediment Control Act, stream encroachment and cultural resources requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ NAAQS. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act, stream encroachment and cultural resources requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ NAAQS. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act, stream encroachment and cultural resources requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ NAAQS. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would meet LDR UTSs or a treatability variance.
	LONG TERM EFFECTIVENESS AND PERMANENCE			
Magnitude of Residual Risk	Potential risks associated with VOC emissions would be limited by water cover maintenance. Potential risks associated with high Btu tar constituent migration would remain.	Residual risk would be minimized by high Btu tar removal, solidification for strength and reduction of metals leachability, and containment in Impound 8.	Residual risk would be minimized by high Btu tar removal, treatment, solidification for strength and reduction of metals leachability, and containment in the Impound 8.	Residual risk would be minimized by high Btu tar removal, treatment, solidification for strength and reduction of metals leachability, and containment in Impound 8.

Table 8-1. ***Detailed Analysis of Alternatives - Category A: High Btu tar***

	Alternative A1 **No Action/Institutional Actions**	**Alternative A2** **Consolidation in Impound 8**	**Alternative A3** **LTTT**	**Alternative A4** **On-Site Incineration**
Adequacy and Reliability of Controls	Fencing and land use restrictions would have limited reliability for limiting human contact. Water cover maintenance would be adequate and reliable for minimizing potential risks associated with VOC emissions. Monitoring would be adequate and reliable for tracking impacts to ground water. Institutional actions would not control potential for constituent migration.	Removal and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of high Btu tar constituents to environmental media.	Removal, LTTT, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of high Btu tar constituents to environmental media.	Removal, incineration, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of high Btu tar constituents to environmental media.
	REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT			
Treatment Process Used and Materials Treated	No treatment.	Strength conditioning solidification of high Btu tar. Treatment of off-gas.	TEMD pretreatment, LTTT, and post-conditioning (solidification) of high Btu tar. Treatment of off-gas.	Pretreatment and incineration of high Btu tar. Post-conditioning solidification of residual ash. Treatment of off-gas.
Amount of Hazardous Material Destroyed or Treated	No treatment.	Conditioning of high Btu tar necessary to meet Impound 8 strength requirements and as needed to reduce metals leachability.	TEMD, LTTT, and post-conditioning would reduce high Btu tar material organic and metal constituents to below Group III treatment objectives.	Pretreatment, incineration, and post-conditioning would reduce high Btu tar material organic and metal constituents to below Group III treatment objectives.
Degree of Expected Reduction of Toxicity, Mobility or Volume	Institutional actions would not provide for reduction of toxicity, mobility, or volume of high Btu tar.	Minimization of high Btu tar mobility with solidification and containment in Impound 8. Approximately 10% net volume increase with strength conditioning solidification.	Minimization of high Btu tar toxicity and mobility with LTTT, solidification, and treatment residual containment in Impound 8. Approximate 25% net volume increase expected with treatment train.	Minimization of high Btu tar toxicity and mobility with incineration, solidification, and treatment residual containment in Impound 8. Approximate 80% net volume decrease expected with treatment train.

Table 8-1. ***Detailed Analysis of Alternatives - Category A: High Btu tar***

	Alternative A1 No Action/Institutional Actions	Alternative A2 Consolidation in Impound 8	Alternative A3 LTTT	Alternative A4 On-Site Incineration
Degree to Which Treatment is Irreversible	No treatment.	Solidification conditioning would be irreversible.	TEMD, LTTT, and post-conditioning (solidification) would be irreversible.	Pretreatment, incineration, and post-conditioning (solidification) would be irreversible.
Type and Quantity of Residuals Remaining After Treatment	No treatment.	Approximately 53,000 ton (48,000 yd^3) conditioned material. Air pollution control residuals.	Approximately 53,000 ton (54,000 yd^3) treated, post-conditioned High Btu tar. Air pollution control residuals consisting of condensate, wastewater, and solid phase adsorbent.	Approximately 13,000 ton (9,000 yd^3) post-conditioned residual ash. Air pollution control scrubber wastewater residuals.
	SHORT-TERM EFFECTIVENES			
Protection of Community During Remedial Actions	Fencing would restrict community access to Impoundments 1 and 2. Water cover maintenance would minimize VOC emissions from Impoundments 1 and 2. Future land use would be restricted. No impacts to community from ground water monitoring.	Community would be restricted from access to Impoundments 1 and 2 during remediation. Vapor emissions/odors during materials handling and conditioning would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of high Btu tar material.	Community would be restricted from access to Impoundments 1 and 2 during remediation. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated high Btu tar material.	Community would be restricted from access to Impoundments 1 and 2 during remediation. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated high Btu tar material.
Protection of Workers During Remedial Actions	Appropriate protective equipment would be utilized during monitoring activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.
Environmental Impacts	Continued potential for constituents to migrate.	Minimal environmental impacts with containment of conditioned material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.

Table 8-1. ***Detailed Analysis of Alternatives - Category A: High Btu tar***

	Alternative A1 No Action/Institutional Actions	**Alternative A2 Consolidation in Impound 8**	**Alternative A3 LTTT**	**Alternative A4 On-Site Incineration**
Time Until RAO Is Achieved	Removal of material from the impoundments, and minimization of migration of high Btu tar constituents to air, soil and ground water would not be achieved with institutional actions.	RAO would be achieved upon completion of excavation of Impoundment 1 and 2 material, which would be within approximately 1-2 years.	RAO would be achieved upon completion of excavation of Impoundment 1 and 2 material, which would be within approximately 2-5 years.	RAO would be achieved upon completion of excavation of Impoundment 1 and 2 material, which would be within approximately 2-5 years.
	IMPLEMENTABILITY			
Ability to Construct and Operate the Technology	Fencing would be readily constructed. Water cover would be readily maintained. Monitoring would be readily implemented.	Conditioning and placement in Impound 8 would be readily implemented.	Pilot study results indicated that TEMD and LTTT are feasible. Post-conditioning and placement in Impound 8, would be readily implemented.	On-site incineration could be readily constructed and operated, but potential exists for community opposition. Post-conditioning, and placement in Impound 8, would be readily implemented.
Reliability of Technology	Fencing, land use restrictions, water cover maintenance, and monitoring are reliable for their intended functions.	Conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Pilot study results indicate reliability of TEMD and LTTT for organic removal. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Incineration considered reliable for organic destruction. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 1 and 2 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 1 and 2 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 1 and 2 readily implemented, if necessary.

Table 8-1. *Detailed Analysis of Alternatives - Category A: High Btu tar*

	Alternative A1 No Action/Institutional Actions	Alternative A2 Consolidation in Impound 8	Alternative A3 LTTT	Alternative A4 On-Site Incineration
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water quality at the site.	Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.
Coordination With Other Agencies	None required.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities, If Necessary	None required.	None required.	None required.	None required.
Availability of Necessary Equipment, Specialist and Materials	Fencing readily available. Sampling equipment, personnel, and analytical laboratories readily available.	Mixing equipment for conditioning readily available.	Mixing equipment for pretreatment and post-conditioning readily available. LTTT equipment and specialists readily available.	Mixing equipment for pretreatment and post-conditioning readily available. Incineration equipment and specialists likely readily available.

Table 8-1. ***Detailed Analysis of Alternatives - Category A: High Btu tar***

	Alternative A1 No Action/Institutional Actions	Alternative A2 Consolidation in Impound 8	Alternative A3 LTTT	Alternative A4 On-Site Incineration
Availability of Prospective Technologies	None required.	Conditioning technologies readily available.	TEMD, LTTT, post-conditioning technologies readily available.	Pretreatment and post-conditioning technologies readily available. Incineration technology likely readily available.
	COST			
Total Estimated Capital Costs	$56,000	$19,000,000	$27,000,000	$35,000,000
Estimated Annual O & M Cost	$14,000	NA	NA	NA
Total Estimated Present Worth Cost (30 yr)	$230,000	$19,000,000	$27,000,000	$35,000,000
USEPA ACCEPTANCE				
Regulatory agency acceptance will be documented in the ROD.				
COMMUNITY ACCEPTANCE				
Community and local government are opposed to on-site incineration.				

Table 8-2 *Alternative A1 Cost Estimate - No Action/Institutional Actions*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Land Use Restrictions	1	Lump Sum	$2,500	$2,500	
Fencing	1	Lump Sum	$36,000	$36,000	
				Subtotal	$38,500
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$9,625
Engineering (15% Direct capital cost)					$5,775
Administration (5% Direct capital cost)					$1,925
TOTAL CAPITAL COST					**$55,825**
OPERATION & MAINTENANCE COSTS					
Maintain Water Cover	1	Lump Sum	$540	$540	
Ground Water Monitoring	1	Lump Sum	$13,750	$13,750	
PRESENT WORTH OPERATION & MAINTENANCE COST (7% for 30 yr)					**$177,325**
TOTAL PRESENT WORTH COST					**$233,150**
ROUNDED TO					**$230,000**

Table 8-3. *Alternative A2 Cost Estimate - Consolidation in Impound 8*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$7,400	$7,400	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	43,500	C.Y.	$25	$1,087,500	
Sheet Piling	1	Lump Sum	$1,600,000	$1,600,000	
Site Preparation (Building and Concrete Pad)	1	Lump Sum	$195,000	$195,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$1,650,000	$1,650,000	
Treatment					
Material Handling Conditioning					
-Portland Cement Addition	8,500	Ton	$70	$595,000	
-Aggregate Addition	500	Ton	$20	$10,000	
-Fly Ash Addition	7,100	Ton	$10	$71,000	
Material Handling Conditioning					
-Portland Cement Processing	58,224	Ton	$15	$873,360	
-Aggregate Processing/Screening	58,224	Ton	$35	$2,037,840	
-Fly Ash Processing	58,224	Ton	$10	$582,240	
-Air Pollution Control	42,500	Ton	$30	$1,275,000	
-Equipment/Material Handling	58,224	Ton	$3	$174,672	
Strength Conditioning Materials	10,626	Ton	$52	$552,552	
Strength Conditioning Processing					
-Material Processing/Handling	53,130	Ton	$16	$850,080	
-Air Pollution Control	42,500	Ton	$10	$425,000	
Material Strength Testing	680	Sample	$85	$57,773	
Final Material Placement					
Transportation to Impound 8	54,375	C.Y.	$5	$271,875	
Placement into Impound 8	54,375	C.Y.	$8	$435,000	
				Subtotal	$12,777,292
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$3,194,323
Engineering (15% Direct capital cost)					$1,916,594
Administration (5% Direct capital cost)					$638,865
TOTAL CAPITAL COST					**$18,527,074**
TOTAL PRESENT WORTH COST					**$18,527,074**
ROUNDED TO					**$19,000,000**

Table 8-4. *Alternative A3 Cost Estimate - LTTT*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$7,400	$7,400	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	43,500	C.Y.	$25	$1,087,500	
Sheet Piling	1	Lump Sum	$1,600,000	$1,600,000	
Site Preparation (Building and Concrete Pad)	1	Lump Sum	$195,000	$195,000	
Thermal Treatment Equipment Mob/Demob	1	Lump Sum	$800,000	$800,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$1,650,000	$1,650,000	
Treatment					
Pre-treatment (TEMD) Conditioning Materials					
-Portland Cement Addition	8,500	Ton	$70	$595,000	
-Aggregate Addition	500	Ton	$20	$10,000	
-Fly Ash Addition	7,100	Ton	$10	$71,000	
Pre-Treatment (TEMD) Conditioning Processing					
-Portland Cement Processing	58,224	Ton	$15	$873,360	
-Aggregate Processing/Screening	58,224	Ton	$35	$2,037,840	
-Fly Ash Processing	58,224	Ton	$10	$582,240	
-Air Pollution Control	42,500	Ton	$30	$1,275,000	
-Equipment/Material Handling	58,224	Ton	$3	$174,672	
Low Temperature Thermal Treatment	58,224	Ton	$85	$4,949,040	
Post-treatment Conditioning Materials	10,626	Ton	$52	$552,552	
Post-treatment Conditioning Processing					
-Material Processing/Handling	53,130	Ton	$16	$850,080	
-Air Pollution Control	42,500	Ton	$10	$425,000	
Material Strength Testing	680	Sample	$85	$57,773	
Final Material Placement					
Transportation to Impound 8	54,375	C.Y.	$5	$271,875	
Placement into Impound 8	54,375	C.Y.	$8	$435,000	
				Subtotal	$18,526,332
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$4,631,583
Engineering (15% Direct capital cost)					$2,778,950
Administration (5% Direct capital cost)					$926,317
TOTAL CAPITAL COST					**$26,863,182**
TOTAL PRESENT WORTH COST					**$26,863,182**
ROUNDED TO					**$27,000,000**

Table 8-5 *Alternative A4 Cost Estimate - On-site Incineration*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
<u>Site Work</u>					
Mobilization/Demobilization	1	Lump Sum	$3,000	$3,000	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	43,500	C.Y.	$25	$1,087,500	
Sheet Piling	1	Lump Sum	$1,600,000	$1,600,000	
Site Preparation	1	Lump Sum	$195,000	$195,000	
Incineration Mob/Demob	1	Lump Sum	$2,000,000	$2,000,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$900,000	$900,000	
<u>Treatment</u>					
Pre-treatment Conditioning Materials	8,500	Ton	$70	$595,000	
Pre-treatment Conditioning Processing	51,000	Ton	$15	$765,000	
Air Pollution Control	42,500	Ton	$30	$1,275,000	
Incineration	51,000	Ton	$300	$15,300,000	
Post-treatment Conditioning Materials	2,550	Ton	$52	$132,600	
Post-treatment Conditioning Processing	12,750	Ton	$15	$191,250	
Material Strength Testing	109	Sample	$85	$9,244	
<u>Final Material Placement</u>					
Transportation to Impound 8	8,700	C.Y.	$5	$43,500	
Placement into Impound 8	8,700	C.Y.	$8	$69,600	
				Subtotal	$24,192,694
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$6,048,173
Engineering (15% Direct capital cost)					$3,628,904
Administration (5% Direct capital cost)					$1,209,635
TOTAL CAPITAL COST					**$35,079,406**
TOTAL PRESENT WORTH COST					**$35,079,406**
ROUNDED TO					**$35,000,000**

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT					
Protection of Human Health	Institutional actions would provide a slight increase in the level of protection from human exposure.	Removal and containment in Impound 8 would minimize human exposure to low Btu tar/sludge material.	Removal, bioremediation and containment in Impound 8 would minimize human exposure to low Btu tar/sludge material.	Removal, LTTT, and containment in Impound 8 would minimize human exposure to low Btu tar/sludge material.	Removal, incineration, and containment in Impound 8 would minimize human exposure to low Btu tar/sludge material.
Protection of Environment	The potential for low Btu tar/sludge constituent migration would remain.	Removal, of low Btu tar/sludge would minimize constituent migration to environmental media.	Removal, of low Btu tar/sludge would minimize constituent migration to environmental media.	Removal, of low Btu tar/sludge would minimize constituent migration to environmental media.	Removal, of low Btu tar/sludge would minimize constituent migration to environmental media.
COMPLIANCE WITH ARARS					
Chemical-specific ARARs	None identified	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be attained through incineration, or by obtaining a treatability variance.
Location-specific ARARs	None identified	Remedial actions would be conducted in accordance with floodplain and wetland requirements.	Remedial actions would be conducted in accordance with floodplain and wetland requirements.	Remedial actions would be conducted in accordance with floodplain and wetland requirements.	Remedial actions would be conducted in accordance with floodplain and wetland requirements.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
Action-specific ARARs	Monitoring activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, and OSHA requirements.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of material in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would meet LDR UTSs or a treatability variance.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
LONG TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of Residual Risk	Potential risks associated with VOC emissions would be limited by water cover maintenance. Potential risks associated with low Btu tar/sludge constituent migration would remain.	Residual risk would be minimized by low Btu tar/sludge removal, solidification for strength and reduction of metals leachability, and containment in the Impound 8 facility.	Residual risk would be minimized by low Btu tar/sludge removal, treatment, solidification for strength and reduction of metals leachability, and containment in the Impound 8 facility.	Residual risk would be minimized by low Btu tar/sludge removal, treatment, solidification for strength and reduction of metals leachability, and containment in the Impound 8 facility.	Residual risk would be minimized by low Btu tar/sludge removal, treatment, solidification for strength and reduction of metals leachability, and containment in the Impound 8 facility.
Adequacy and Reliability of Controls	Site controls and land use restrictions would have limited reliability for limiting human contact. Water cover maintenance would be adequate and reliable for minimizing potential risks associated with VOC emissions. Monitoring would be adequate and reliable for tracking impacts to environmental media. Institutional actions would not control potential for constituent migration.	Removal and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of low Btu tar/sludge constituents to environmental media.	Removal, bioremediation, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of low Btu tar/sludge constituents to environmental media.	Removal, LTTT, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of low Btu tar/sludge constituents to environmental media.	Removal, incineration, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of low Btu tar/sludge constituents to environmental media.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT					
Treatment Process Used and Materials Treated	No treatment.	Strength conditioning solidification of low Btu tar/sludge. Treatment of off-gas.	Conditioning, bioremediation, and post-conditioning solidification of low Btu tar/sludge. Treatment of off-gas.	TEMD pretreatment, LTTT, and post-conditioning solidification of low Btu tar/sludge. Treatment of off-gas.	Pretreatment and incineration of low Btu tar/sludge. Post-conditioning solidification of residual ash. Treatment of off-gas.
Amount of Hazardous Material Destroyed or Treated	No treatment.	Conditioning of low Btu tar/sludge necessary to meet Impound 8 strength requirements and as needed to reduce metals leachability.	Conditioning, bioremediation, and post-conditioning would reduce low Btu tar/sludge material organic constituents and metals to meet Group III treatment objectives.	TEMD, LTTT, and post-conditioning would reduce low Btu tar/sludge material organic and metals constituents to below Group III treatment objectives.	Pretreatment, incineration, and post-conditioning would reduce low Btu tar/sludge material organic and metals constituents to below Group III treatment objectives.
Degree of Expected Reduction of Toxicity, Mobility or Volume	Institutional actions would not provide for reduction of toxicity, mobility, or volume of low Btu tar/sludge.	Minimization of low Btu tar/sludge mobility with residual solidification and containment in Impound 8. Approximately 10% net volume increase with strength conditioning solidification.	Minimization of low Btu tar/sludge toxicity and mobility with bioremediation, solidification, and treatment residual containment in Impound 8. Approximate 200% net volume increase expected with treatment train.	Minimization of low Btu tar/sludge toxicity and mobility with LTTT, solidification, and treatment residual containment in Impound 8. Approximate 25% net volume increase expected with treatment train.	Minimization of low Btu tar/sludge toxicity and mobility with incineration, solidification, and treatment residual containment in Impound 8. Approximate 80% net volume decrease expected with treatment train.
Degree to Which Treatment is Irreversible	No treatment.	Conditioniong solidification would be irreversable.	Conditioning, bioremediation, and post-conditioning solidification would be irreversible.	TEMD, LTTT, and post-conditioning solidification would be irreversible.	Pretreatment, incineration, and post-conditioning solidification would be irreversible.

Table 8-6. *Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge*

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
Type and Quantity of Residuals Remaining After Treatment	No treatment.	Approximately 120,000 ton (100,000 yd^3) conditioned low Btu sludge. Conditioned low Btu tar/sludge. Air pollution control residuals.	Approximately 429,000 ton (262,000 yd^3) treated, post-conditioned low Btu tar/sludge. Air pollution control residuals, likely consisting of solid-phase adsorbent.	Approximately 100,000 ton (91,000 yd^3) treated, post-conditioned low Btu tar/sludge. Air pollution control residuals consisting of condensate, wastewater, and solid-phase adsorbent.	Approximately 29,000 ton (18,000 yd^3) post-conditioned residual ash. Air pollution control residuals consisting of scrubber wastewater.
SHORT-TERM EFFECTIVENESS					
Protection of Community During Remedial Actions	Community is restricted from access to Impoundments 4, 5, 14, and 20. Water cover maintenance would minimize VOC emissions from Impoundments 4, 5, and 14. Future land use would be restricted. No impacts to community from ground water monitoring.	Community is restricted from access to Impoundments 4, 5, 14, and 20. Vapor emissions/odors during materials handling would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated low Btu tar/sludge.	Community is restricted from access to Impoundments 4, 5, 14, and 20. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated low Btu tar/sludge.	Community is restricted from access to Impoundments 4, 5, 14, and 20. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated low Btu tar/sludge.	Community is restricted from access to Impoundments 4, 5, 14, and 20. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated low Btu tar sludge.
Protection of Workers During Remedial Actions	Appropriate protective equipment would be utlized during monitoring activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
Environmental Impacts	Continued potential for low Btu tar/sludge constituents to migrate to ground water.	Minimal environmental impacts with containment of material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.
Time Until RAO Is Achieved	Removal of the material from the impoundments and minimization of migration of low Btu tar/sludge constituents to air, soil, and ground water would not be achieved with institutional actions.	RAO would be achieved upon completion of excavation of Impoundments 4, 5 (wet portion), 14, and 20 material, which would be within approximately 1 to 2 yrs.	RAO would be achieved upon completion of excavation of Impoundment 4, 5 (wet portion), 14 and 20 material, which would be within approximately 5 to 7 yr.	RAO would be achieved upon completion of excavation of Impoundment 4, 5 (wet portion), 14 and 20 material, which would be within approximately 3 to 4 yr.	RAO would be achieved upon completion of excavation of Impoundment 4, 5 (wet portion), 14, and 20 material, which would be within 4 to 5 yr.
			IMPLEMENTABILITY		
Ability to Construct and Operate the Technology	Water cover would be readily maintained. Monitoring would be readily implemented.	Conditioning and placement in Impound 8 would be readily implemented.	Pilot study results indicated that bioremediation is feasible. Post-conditioning and placement in Impound 8 would be readily implemented.	Pilot study results indicated that TEMD and LTTT are feasible for the high Btu tar, and could likely be readily implemented for the low Btu tar/sludge. Post-conditioning and placement in Impound 8 would be readily implemented.	On-site incineration could be readily constructed and operated, but potential exists for community opposition. Post-conditioning and placement in Impound 8 would be readily implemented.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	**Alternative B2 Consolidation in Impound 8**	**Alternative B3 Bioremediation**	**Alternative B4 LTTT**	**Alternative B5 On-Site Incineration**
Reliability of Technology	Land use restrictions, water cover maintenance, and monitoring are reliable for their intended functions.	Condiitoning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Pilot study results indicate reliability of bioremediation for organic removal. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Pilot study results indicate reliability of TEMD and LTTT for organic removal for Impoundments 1 and 2; TEMD and LTTT are expected to be reliable for low Btu tar/sludge. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Incineration considered reliable for organic destruction. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 4, 5 (wet portion), 14, and 20 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 4, 5 (wet portion), 14, and 20 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 4, 5 (wet portion), 14, and 20 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 4, 5 (wet portion), 14, and 20 readily implemented, if necessary.
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water quality at the site.	Strength sampling/analysis would indicate attainment of strength requirements. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	**Alternative B2 Consolidation in Impound 8**	**Alternative B3 Bioremediation**	**Alternative B4 LTTT**	**Alternative B5 On-Site Incineration**
Coordination With Other Agencies	None required.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain and wetland areas. Army Corps of Engineers approval under Nationwide Permit #38 potentially required for backfill in a wetland area.
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities, If Necessary	None required.	None required.	None required.	None required.	None required.
Availability of Necessary Equipment, Specialist and Materials	Sampling equipment, personnel, and analytical laboratories readily available.	Mixing equipment for conditioning readily available.	Mixing equipment for pretreatment and post-conditioning readily available. Bioremediation equipment and specialists readily available.	Mixing equipment for pretreatment and post-conditioning readily available. LTTT equipment and specialists readily available.	Mixing equipment for pretreatment and post-conditioning readily available. Incineration equipment and specialists likely readily available.
Availability of Prospective Technologies	None required.	Conditioning technologies readily available.	Bioremediation equipment readily available.	TEMD, LTTT, post-conditioning technologies readily available.	Pretreatment and post-conditioning technologies readily available. Incineration technology likely readily available.

Table 8-6. ***Detailed Analysis of Alternatives - Category B: Low Btu Tar/Sludge***

	Alternative B1 No Action/Institutional Actions	Alternative B2 Consolidation in Impound 8	Alternative B3 Bioremediation	Alternative B4 LTTT	Alternative B5 On-Site Incineration
	COST				
Total Estimated Capital Costs	$3,600	$14,000,000	$33,000,000	$41,000,000	$66,000,000
Estimated Annual O & M Cost	$14,000	NA	NA	NA	NA
Total Estimated Present Worth Cost (30 yr)	$180,000	$14,000,000	$33,000,000	$41,000,000	$66,000,000
USEPA ACCEPTANCE					
Regulatory agency acceptance will be documented in the ROD.					
COMMUNITY ACCEPTANCE					
Community and local government are opposed to on-site incineration.					

Table 8-7 *Alternative B1 Cost Estimate - No Action/Institutional Actions*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Land Use Restrictions	1	Lump Sum	$2,500	$2,500	
				Subtotal	$2,500
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$625
Engineering (15% Direct capital cost)					$375
Administration (5% Direct capital cost)					$125
TOTAL CAPITAL COST					**$3,625**
OPERATION & MAINTENANCE COSTS					
Maintain Water Cover	1	Lump Sum	$540	$540	
Ground Water Monitoring	1	Lump Sum	$13,750	$13,750	
PRESENT WORTH OPERATION & MAINTENANCE COST (7% for 30 yr)					**$177,325**
TOTAL PRESENT WORTH COST					**$180,950**
ROUNDED TO					**$180,000**

Table 8-8. *Alternative B2 Cost Estimate - Consolidation in Impound 8*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$7,400	$7,400	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	87,700	C.Y.	$17	$1,490,900	
Site Preparation (Building and Concrete Pad)	1	Lump Sum	$195,000	$195,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$750,000	$750,000	
Conditioning					
Conditioning Materials	23,919	Ton	$52	$1,243,788	
Conditioning Processing					
-Material Processing/Handling	119,600	Ton	$16	$1,913,600	
-Air Pollution Control	95,681	Ton	$25	$2,392,025	
Material Strength Testing	1,250	Sample	$85	$106,250	
Final Material Placement					
Transportation to Impound 8	99,916	C.Y.	$5	$499,580	
Placement into Impound 8	99,916	C.Y.	$8	$799,328	
				Subtotal	$9,423,871
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$2,355,968
Engineering (15% Direct capital cost)					$1,413,581
Administration (5% Direct capital cost)					$471,194
TOTAL CAPITAL COST					**$13,664,613**
TOTAL PRESENT WORTH COST					**$13,664,613**
ROUNDED TO					**$14,000,000**

Table 8-9. *Alternative B3 Cost Estimate - Solid-phase Bioremediation*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$3,000	$3,000	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	87,700	C.Y.	$17	$1,490,900	
Site Preparation	1	Lump Sum	$195,000	$195,000	
Bioremdiation Unit Mob/Demob	1	Lump Sum	$150,000	$150,000	
Treatment					
Pre-treatment Conditioning	261,950	C.Y.	$14	$3,667,300	
Biological Treatment Processing	261,950	C.Y.	$30	$7,858,500	
Chemical Analysis	1	Lump Sum	$330,000	$330,000	
Biological Analysis	1	Lump Sum	$85,000	$85,000	
Post-treatment Conditioning	285,787	Ton	$16	$4,572,599	
Material Strength Testing	3,274	Sample	$85	$278,322	
Air Control	95,681	Ton	$10	$956,810	
Final Material Placement					
Transportation to Impound 8	261,950	C.Y.	$5	$1,309,750	
Placement into Impound 8	261,950	C.Y.	$8	$2,095,600	
				Subtotal	$23,018,781
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$5,754,695
Engineering (15% Direct capital cost)					$3,452,817
Administration (5% Direct capital cost)					$1,150,939
TOTAL CAPITAL COST					**$33,377,233**
TOTAL PRESENT WORTH COST					**$33,377,233**
ROUNDED TO					**$33,000,000**

Table 8-10. *Alternative B4 Cost estimate - LTTT*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$7,400	$7,400	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	87,700	C.Y.	$17	$1,490,900	
Site Preparation (Building and Concrete Pad)	1	Lump Sum	$195,000	$195,000	
Thermal Treatment Equipment Mob/Demob	1	Lump Sum	$800,000	$800,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$1,650,000	$1,650,000	
Treatment					
Pre-treatment (TEMD) Conditioning Materials					
- Portland Cement Addition	19,136	Ton	$70	$1,339,520	
- Aggregate Addition	500	Ton	$20	$10,000	
Pre-treatment (TEMD) Conditioning Processing					
- Portland Cement Processing	114,817	Ton	$15	$1,722,255	
- Aggregate Processing/Screening	114,817	Ton	$35	$4,018,595	
- Air Pollution Control	95,681	Ton	$25	$2,392,025	
- Equipment/Material Handling	114,817	Ton	$3	$344,451	
Low Temperature Thermal Treatment	114,817	Ton	$85	$9,759,445	
Post-treatment Conditioning Materials	19,806	Ton	$52	$1,029,912	
Post-treatment Conditioning Processing					
- Material Processing/Handling	99,030	Ton	$16	$1,584,480	
- Air Pollution Control	95,681	Ton	$10	$956,810	
Material Strength Testing	1,140	Sample	$85	$96,900	
Final Material Placement					
Transportation to Impound 8	91,208	C.Y.	$5	$456,040	
Placement into Impound 8	91,208	C.Y.	$8	$729,664	
				Subtotal	$28,609,397
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$7,152,349
Engineering (15% Direct capital cost)					$4,291,410
Administration (5% Direct capital cost)					$1,430,470
TOTAL CAPITAL COST					**$41,483,626**
TOTAL PRESENT WORTH COST					**$41,483,626**
ROUNDED TO					**$41,000,000**

Table 8-11. *Alternative B5 Cost Estimate - On-site Incineration*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$3,000	$3,000	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	87,700	C.Y.	$17	$1,490,900	
Site Preparation	1	Lump Sum	$195,000	$195,000	
Incineration Mob/Demob	1	Lump Sum	$2,000,000	$2,000,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$900,000	$900,000	
Treatment					
Pre-treatment Conditioning Materials	19,136	Ton	$70	$1,339,520	
Pre-treatment Conditioning Processing	114,817	Ton	$15	$1,722,255	
Air Pollution Control	95,681	Ton	$25	$2,392,025	
Incineration	114,817	Ton	$300	$34,445,100	
Post-treatment Conditioning Materials	5,741	Ton	$52	$298,532	
Post-treatment Conditioning Processing	28,704	Ton	$15	$430,560	
Material Strength Testing	219	Sample	$85	$18,636	
Final Material Placement					
Transportation to Impound 8	17,540	C.Y.	$5	$87,700	
Placement into Impound 8	17,540	C.Y.	$8	$140,320	
				Subtotal	$45,489,548
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$11,372,387
Engineering (15% Direct capital cost)					$6,823,432
Administration (5% Direct capital cost)					$2,274,477
TOTAL CAPITAL COST					**$65,959,845**
TOTAL PRESENT WORTH COST					**$65,959,845**
ROUNDED TO					**$66,000,000**

Table 8-12 ***Detailed Analysis of Alternatives - Category C: Impoundment 3***

	Alternative C1 No Action/Institutional Actions	**Alternative C2 Consolidation in Impound 8**	**Alternative C3 LTTT**	**Alternative C4 On-Site Incineration**
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT				
Protection of Human Health	Institutional actions would provide a slight increase in the level of protection from human exposure.	Removal and containment in Impound 8 would minimize human exposure to Impoundment 3 material.	Removal, LTTT, and containment in Impound 8 would minimize human exposure to Impoundment 3 material.	Removal, incineration, and containment in Impound 8 would minimize human exposure to Impoundment 3 material.
Protection of Environment	The potential for Impoundment 3 constituent migration would remain.	Removal of Impoundment 3 material would minimize constituent migration to environmental media.	Removal of Impoundment 3 material would minimize constituent migration to environmental media.	Removal of Impoundment 3 material would minimize constituent migration to environmental media.
COMPLIANCE WITH ARARS				
Chemical-specific ARARs	None identified	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be achieved through development of alternate treatment standards under a CAMU.	LDR UTSs would be attained with incinceration, or by obtaining a treatability variance.
Location-specific ARARs	None identified	Remedial actions would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.

Table 8-12 *Detailed Analysis of Alternatives - Category C: Impoundment 3*

	Alternative C1 No Action/Institutional Actions	**Alternative C2 Consolidation in Impound 8**	**Alternative C3 LTTT**	**Alternative C4 On-Site Incineration**
Action-specific ARARs	Monitoring activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, and OSHA requirements.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated hazardous waste in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated material in Impound 8 would be performed within a CAMU designation.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ ambient air quality standards. Generation, handling, and treatment of hazardous waste would be conducted in accordance with NJ hazardous waste management regulations. Transport of treated material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements. Placement of treated hazardous waste in Impound 8 would meet LDR UTSs or a treatability variance.

Table 8-12 ***Detailed Analysis of Alternatives - Category C: Impoundment 3***

	Alternative C1 No Action/Institutional Actions	Alternative C2 Consolidation in Impound 8	Alternative C3 LTTT	Alternative C4 On-Site Incineration
LONG TERM EFFECTIVENESS AND PERMANENCE				
Magnitude of Residual Risk	Potential risks associated with Impoundment 3 constituent migration would remain.	Residual risk would be minimized by Impoundment 3 removal, solidification for strength and reduction of metals leachability, and containment in Impound 8.	Residual risk would be minimized by Impoundment 3 removal, treatment, solidification for strength and reduction of metals leachability, and containment in Impound 8.	Residual risk would be minimized by Impoundment 3 removal, treatment, solidification for strength and reduction of metals leachability, and containment in Impound 8.
Adequacy and Reliability of Controls	Site controls and land use restrictions would have limited reliability for limiting human contact. Monitoring would be adequate and reliable for tracking impacts to ground water. Institutional actions would not control potential for constituent migration.	Removal and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of Impoundment 3 constituents to environmental media.	Removal, LTTT, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of Impoundment 3 constituents to environmental media.	Removal, incineration, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of Impoundment 3 constituents to environmental media.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT				
Treatment Process Used and Materials Treated	No treatment.	Strength conditioning solidification of Impoundment 3 material. Treatment of off-gas.	TEMD pretreatment, LTTT, and post-conditioning solidification of Impoundment 3 material. Treatment of off-gas.	Pretreatment and incineration of Impoundment 3 material. Post-conditioning (solidification) of residual ash. Treatment of off-gas.
Amount of Hazardous Material Destroyed or Treated	No treatment.	Conditioning of Impoundment 3 material necessary to meet Impound 8 strength requirements and as needed to reduce metals leachability.	TEMD, LTTT, and post-conditioning would reduce Impoundment 3 material organic and metals constituents to below Group III treatment objectives.	Pretreatment, incineration, and post-conditioning would reduce Impoundment 3 material organic and metals constituents to below Group III treatment objectives.

Table 8-12 *Detailed Analysis of Alternatives - Category C: Impoundment 3*

	Alternative C1 No Action/Institutional Actions	**Alternative C2 Consolidation in Impound 8**	**Alternative C3 LTTT**	**Alternative C4 On-Site Incineration**
Degree of Expected Reduction of Toxicity, Mobility or Volume	Institutional actions would not provide for reduction of toxicity, mobility, or volume of Impoundment 3 material.	Minimization of Impoundment 3 material mobility with solidification and containment in Impound 8. Approximately 10% net volume increase with strength conditioning solidification.	Minimization of Impoundment 3 material toxicity and treatment residual mobility with LTTT, solidification, and containment in Impound 8. There would be a net volume increase of approximately 30%.	Minimization of Impoundment 3 material toxicity and mobility with incineration, solidification, and treatment residual containment in Impound 8. Approximate 80% net volume decrease expected with treatment train.
Degree to Which Treatment is Irreversible	No treatment.	Conditioning solidification would be irreversible.	Pretreatment, LTTT, and post-conditioning solidification would be irreversible.	Pretreatment, incineration, and post-conditioning solidification would be irreversible.
Type and Quantity of Residuals Remaining After Treatment	No treatment.	Approximately 16,000 ton (18,000 yd^3) conditioned Impoundment 3 material. Air pollution control residuals.	Approximately 17,000 ton (22,000 yd^3) treated, post-conditioned higher Btu value tar. Air pollution control residuals consisting of condensate, wastewater, and solid-phase adsorbent.	Approximately 4,900 ton (4,400 yd^3) post-conditioned residual ash. Air pollution control residuals consisting of scrubber wastewater.

Table 8-12 ***Detailed Analysis of Alternatives - Category C: Impoundment 3***

	Alternative C1 No Action/Institutional Actions	**Alternative C2 Consolidation in Impound 8**	**Alternative C3 LTTT**	**Alternative C4 On-Site Incineration**
		SHORT-TERM EFFECTIVENESS		
Protection of Community During Remedial Actions	Community is restricted from access to Impoundment 3. Future land use would be restricted. No impacts to community from ground water monitoring.	Community would be restricted from access to Impoundment 3. Vapor emissions/odors during materials handling would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated higher Btu value material.	Community would be restricted from access to Impoundment 3 during remediation. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated higher Btu value material.	Community would be restricted from access to Impoundment 3 during remediation. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of treated higher Btu value material.
Protection of Workers During Remedial Actions	Appropriate protective equipment would be utilized during monitoring activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.
Environmental Impacts	Continued potential for constituents to migrate.	Minimal environmental impacts with containment of material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.	Minimal environmental impacts with containment of treated, stabilized material in Impound 8.
Time Until RAO Is Achieved	Removal of the material from the impoundment and minimization of migration of Impoundment 3 constituents to air, soil, and ground water would not be achieved with institutional actions.	RAO, would be achieved upon completion of excavation of Impoundment 3 material, within approximately 1 yr.	RAO, would be achieved upon completion of excavation of Impoundment 3 material, which would be within approximately 1 to 2 yr.	RAO would be achieved upon completion of excavation of Impoundment 3 material, which would be within approximately 1 to 3 yr.

Table 8-12 *Detailed Analysis of Alternatives - Category C: Impoundment 3*

	Alternative C1 No Action/Institutional Actions	Alternative C2 Consolidation in Impound 8	Alternative C3 LTTT	Alternative C4 On-Site Incineration
IMPLEMENTABILITY				
Ability to Construct and Operate the Technology	Monitoring would be readily implemented.	Conditioning and placement in Impound 8 would be readily implemented.	Pilot study results indicated that TEMD and LTTT is feasible for Impoundments 1 and 2, and would likely be readily implementable for Impoundment 3. Post-conditioning and placement in Impound 8 would be readily implemented.	On-site incineration could be readily constructed and operated, but potential exists for community opposition. Post-conditioning and placement in Impound 8 would be readily implemented.
Reliability of Technology	Land use restrictions and monitoring are reliable for their intended functions.	Conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Pilot study results indicate reliability of TEMD and LTTT for organic removal for Impoundments 1 and 2; TEMD and LTTT expected to be reliable for Impoundment 3. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.	Incineration considered reliable for organic destruction. Post-conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundment 3 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundment 3 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundment 3 readily implemented, if necessary.

Table 8-12 ***Detailed Analysis of Alternatives - Category C: Impoundment 3***

	Alternative C1 No Action/Institutional Actions	Alternative C2 Consolidation in Impound 8	Alternative C3 LTTT	Alternative C4 On-Site Incineration
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water quality at the site.	Strength sampling/analysis would indicate attainment of strength requirements. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Post-treatment evaluation sampling/analysis would indicate effectiveness of treatment in meeting Group III treatment objectives. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.
Coordination With Other Agencies	None required.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities, If Necessary	None required.	None required.	None required.	None required.
Availability of Necessary Equipment, Specialist and Materials	Sampling equipment, personnel, and analytical laboratories readily available.	Equipment for conditioning readily available.	Mixing equipment for pretreatment and post-conditioning readily available. LTTT equipment and specialists readily available.	Mixing equipment for pretreatment and post-conditioning readily available. Incineration equipment and specialists likely readily available.
Availability of Prospective Technologies	None required.	Conditioning technologies readily available.	Pretreatment and post-conditioning technologies readily available. LTTT technology readily available.	Pretreatment and post-conditioning technologies readily available. Incineration technology likely readily available.

Table 8-12 *Detailed Analysis of Alternatives - Category C: Impoundment 3*

	Alternative C1 No Action/Institutional Actions	**Alternative C2 Consolidation in Impound 8**	**Alternative C3 LTTT**	**Alternative C4 On-Site Incineration**
	COST			
Total Estimated Capital Costs	$3,600	$3,000,000	$10,000,000	$14,800,000
Estimated Annual O & M Cost	$14,000	NA	NA	NA
Total Estimated Present Worth Cost (30 yr)	$170,000	$3,000,000	$10,000,000	$14,800,000
USEPA ACCEPTANCE				
Regulatory agency acceptance will be documented in the ROD.				
COMMUNITY ACCEPTANCE				
Community and local government are opposed to on-site incineration.				

Table 8-13. *Alternative C1 Cost Estimate - No Action/Institutional Actions*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
<u>Site Work</u>					
Land Use Restrictions	1	Lump Sum	$2,500	$2,500	
				Subtotal	$2,500
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$625
Engineering (15% Direct capital cost)					$375
Administration (5% Direct capital cost)					$125
TOTAL CAPITAL COST					**$3,625**
OPERATION & MAINTENANCE COSTS					
Ground Water Monitoring	1	Lump Sum	$13,750	$13,750	
PRESENT WORTH OPERATION & MAINTENANCE COST (7% for 30 yr)					**$170,624**
TOTAL PRESENT WORTH COST					**$174,249**
ROUNDED TO					**$170,000**

Table 8-14. *Alternative C2 Cost Estimate - Consolidation in Impound 8*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$2,850	$2,850	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	16,800	C.Y.	$9	$151,200	
Site Preparation (Building and Concrete Pad)	1	Lump Sum	$195,000	$195,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$750,000	$750,000	
Conditioning					
Conditioning Materials	4,062	Ton	$52	$211,224	
Conditioning Processing					
-Material Processing/Handling	20,308	Ton	$16	$324,928	
-Air Pollution Control	16,246	Ton	$25	$406,150	
Material Strength Testing	230	Sample	$85	$19,550	
Final Material Placement					
Transportation to Impound 8	18,504	C.Y.	$5	$92,520	
Placement into Impound 8	18,504	C.Y.	$8	$148,032	
				Subtotal	$2,327,454
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$581,864
Engineering (15% Direct capital cost)					$349,118
Administration (5% Direct capital cost)					$116,373
TOTAL CAPITAL COST					**$3,374,808**
TOTAL PRESENT WORTH COST					**$3,374,808**
ROUNDED TO					**$3,000,000**

Table 8-15. *Alternative C3 Cost Estimate - LTTT*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$2,850	$2,850	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	16,800	C.Y.	$9	$151,200	
Site Preparation (Building and Concrete Pad)	1	Lump Sum	$195,000	$195,000	
Thermal Treatment Equipment Mob/Demob	1	Lump Sum	$800,000	$800,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$1,650,000	$1,650,000	
Treatment					
Pre-treatment (TEMD) Conditioning Materials					
-Portland Cement Addition	3,249	Ton	$70	$227,430	
-Aggregate Addition	500	Ton	$20	$10,000	
Pre-Treatment (TEMD) Conditioning Processing					
-Portland Cement Processing	19,495	Ton	$15	$292,425	
-Aggregate Processing/Screening	19,495	Ton	$35	$682,325	
-Air Pollution Control	16,246	Ton	$25	$406,150	
-Equipment/Material Handling	19,495	Ton	$3	$58,485	
Low Temperature Thermal Treatment	19,495	Ton	$85	$1,657,075	
Post-treatment Conditioning Materials	3,363	Ton	$52	$174,876	
Post-treatment Conditioning Processing					
-Material Processing/Handling	16,814	Ton	$16	$269,024	
-Air Pollution Control	16,246	Ton	$10	$162,460	
Material Strength Testing	273	Sample	$85	$23,205	
Final Material Placement					
Transportation to Impound 8	21,840	C.Y.	$5	$109,200	
Placement into Impound 8	21,840	C.Y.	$8	$174,720	
				Subtotal	$7,072,425
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$1,768,106
Engineering (15% Direct capital cost)					$1,060,864
Administration (5% Direct capital cost)					$353,621
TOTAL CAPITAL COST					**$10,255,016**
TOTAL PRESENT WORTH COST					**$10,255,016**
ROUNDED TO					**$10,000,000**

Table 8-16. *Alternative C4 Cost Estimate - On-site Incineration*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$1,350	$1,350	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	16,800	C.Y.	$9	$151,200	
Site Preparation	1	Lump Sum	$195,000	$195,000	
Incineration Mob/Demob	1	Lump Sum	$2,000,000	$2,000,000	
Conditioning Equipment Mob/Demob	1	Lump Sum	$900,000	$900,000	
Treatment					
Pre-treatment Conditioning Materials	3,249	Ton	$70	$227,430	
Pre-treatment Conditioning Processing	19,495	Ton	$15	$292,425	
Air Pollution Control	16,246	Ton	$25	$406,150	
Incineration	19,495	Ton	$300	$5,848,500	
Post-treatment Conditioning Materials	975	Ton	$52	$50,700	
Post-treatment Conditioning Processing	4,874	Ton	$15	$73,110	
Material Strength Testing	55	Sample	$85	$4,641	
Final Material Placement					
Transportation to Impound 8	4,368	C.Y.	$5	$21,840	
Placement into Impound 8	4,368	C.Y.	$8	$34,944	
				Subtotal	$10,233,290
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$2,558,323
Engineering (15% Direct capital cost)					$1,534,994
Administration (5% Direct capital cost)					$511,665
TOTAL CAPITAL COST					**$14,838,271**
TOTAL PRESENT WORTH COST					**$14,838,271**
ROUNDED TO					**$14,800,000**

Table 8-17. ***Detailed Analysis of Alternatives - Category D: Non-Hazardous Material***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT				
Protection of Human Health	Institutional actions would provide a slight increase in the level of protection from human exposure.	Removal, bioremediation and containment in Impound 8 would minimize human exposure to the category D material.	Removal, conditioning as necessary, and off-site disposal would minimize human exposure to category D material.	Removal, conditioning as necessary, and containment in Impound 8 would minimize human exposure to fill material.
Protection of Environment	The potential for fill constituent migration would remain.	Removal of category D would minimize constituent migration to environmental media.	Removal of category D material would minimize constituent migration to environmental media.	Removal of category D material would minimize constituent migration to environmental media.
COMPLIANCE WITH ARARS				
Chemical-specific ARARs	None identified.	None identified.	None identified.	None identified.
Location-specific ARARs	None identified.	Remedial actions would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.	Remedial actions would be conducted in accordance with floodplain requirements.
Action-specific ARARs	Monitoring activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, and OSHA requirements.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ NAAQS. Transport of material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ NAAQS. Transport of material to off-site disposal facility would be conducted according to federal DOT and NJ transportation requirements.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Air emissions would comply with NJ air pollution control regulations and would not result in exceedence of federal or NJ NAAQS. Transport of material to Impound 8 would be conducted according to federal DOT and NJ transportation requirements.

Table 8-17. *Detailed Analysis of Alternatives - Category D: Non-Hazardous Material*

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
LONG TERM EFFECTIVENESS AND PERMANENCE				
Magnitude of Residual Risk	Potential risks associated with fill constituent migration would remain.	Residual risk would be minimize by removal, conditioning as necessary, and containment in the Impound 8 facility.	Residual risk would be minimized by removal, conditioning as necessary, and containment in an off-site landfill. Inclusion of this material in an off-site hazardous material landfill would displace the future disposal of other waste materials in that landfill.	Residual risk would be minimize by fill removal, conditioning as necessary, and containment in the Impound 8 facility.
Adequacy and Reliability of Controls	Deed restrictions would have limited reliability for limiting human contact. Monitoring would be adequate and reliable for tracking impacts to ground water. Institutional actions would not control potential for constituent migration.	Removal, bioremediation, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of category D material constituents to environmental media.	Removal, conditioning, if necessary, and containment in an off-site landfill would be adequate and reliable to minimizing human exposure and minimizing migration of constituents to environmental media.	Removal, conditioning if necessary, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of non-hazardous fill constituents to environmental media.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT				
Treatment Process Used and Materials Treated	No treatment.	Conditioning of Impoundment 26 materials, bioremediation, and post-conditioning solidification of category D materials. Treatment of off-gas.	Treatment of off-gas, if necessary.	Strength conditioning solidification of fill, if necessary. Treatment of off-gas, if necessary.
Amount of Hazardous Material Destroyed or Treated	No treatment.	Conditioning, bioremediation, and post-conditioning solidification would reduce organic constituents and leachability of metals.	No treatment.	Conditioning solidification of portion of material necessary to meet Impound 8 strength requirements would reduce leachability of metals.

Table 8-17. ***Detailed Analysis of Alternatives - Category D: Non-Hazardous Material***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Degree of Expected Reduction of Toxicity, Mobility or Volume	Institutional actions would not provide for reduction of toxicity, mobility, or volume of non-hazardous fill.	Minimization of Category D material toxicity and mobility with bioremediation, solidification, and treatment residual containment in Impound 8. Approximate net volume increase expected with treatment is 200% for Impoundment 5 material and 100% for Impoundment 26 material.	Minimization of category D material mobility with containment in an off-site landfill.	Minimization of fill mobility with solidification and containment in Impound 8. Approximately 10% net volume increase with strength conditioning solidification, if necessary.
Degree to Which Treatment is Irreversible	No treatment.	Conditioning, bioremediation, and post-conditioning solidification would be irreversible.	No treatment.	Conditioning solidification, if necessary, would be irreversible.
Type and Quantity of Residuals Remaining After Treatment	No treatment.	Approximately 53,300 ton of treated, post-conditioned material. Air pollution control residuals likely consisting of solid-phase adsorbent.	Air pollution control residuals, if necessary, likely consisting of solid-phase adsorbent.	Conditioned fill material, if conditioning necessary. Air pollution control residuals, if necessary, likely consisting of solid-phase adsorbent.
SHORT-TERM EFFECTIVENESS				
Protection of Community During Remedial Actions	Community is restricted from access to Impoundments 5 and 26. Future land use would be restricted. No impacts to community from ground water monitoring.	Community is restricted from access to Impoundments 5 and 26. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of non-hazardous fill material.	Community is restricted from access to Impoundments 5 and 26. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport off-site may impact community.	Community is restricted from access to Impoundments 5 and 26. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of non-hazardous fill material.
Protection of Workers During Remedial Actions	Appropriate protective equipment would be utilized during monitoring activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.

Table 8-17. ***Detailed Analysis of Alternatives - Category D: Non-Hazardous Material***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Environmental Impacts	Continued potential for fill material constituent migration.	Minimal environmental impacts with containment category D material in Impound 8.	Minimal environmental impacts with containment of category D material in an off-site landfill.	Minimal environmental impacts with containment fill material in Impound 8.
Time Until RAOs Are Achieved	Removal of the material from the Impoundments and minimization of migration of fill constituents to air, soil, and ground water would not be achieved with institutional actions.	RAO would be achieved upon completion of excavation of category D material which would be approximately 2 to 3 years.	RAO would be achieved upon completion of excavation of fill material, which would be approximately 1 to 2 yr.	RAO would be achieved upon completion of excavation of fill material, which would be approximately 1 to 2 yr.

Table 8-17. ***Detailed Analysis of Alternatives - Category D: Non-Hazardous Material***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Ability to Construct and Operate the Technology	Monitoring would be readily implemented.	Pilot study results indicated that bioremediation is feasible. Post-conditioning and placement in Impound 8 would be readily implemented.	Conditioning, if necessary, and placement in an off-site landfill would be readily implemented.	Conditioning, if necessary, and placement in Impound 8, would be readily implemented.
Reliability of Technology	Land use restrictions, water cover maintenance, and monitoring are reliable for their intended functions.	Pilot study results indicate reliability of bioremediation for organic removal. Post-conditioning reliable to strength addition. Placement in Impound 8 reliable for long-term residual containment.	Placement in an off-site landfill reliable for long-term residual containment.	Conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 5 and 26 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 5 and 26 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 5 and 26 readily implemented, if necessary.
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water quality at the site.	Strength sampling/analysis would indicate attainment of strength requirements. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Permitted landfill considered to be an effective containment system.	Strength sampling/analysis would indicate attainment of strength requirements. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.
Coordination With Other Agencies	None required.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities, If Necessary	None required.	None required.	Off-site permitted landfill readily available.	None required.

Table 8-17. ***Detailed Analysis of Alternatives - Category D: Non-Hazardous Material***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Availability of Necessary Equipment, Specialist and Materials	Sampling equipment, personnel, and analytical laboratories readily available.	Mixing equipment for pretreatment and post-conditioning readily available. Bioremediation equipment and specialists readily available.	Mixing equipment for conditioning, if necessary, readily available.	Mixing equipment for conditioning readily available.
Availability of Prospective Technologies	None required.	Bioremediation equipment readily available.	None required.	Conditioning technologies readily available.
COST				
Total Estimated Capital Costs	$3,600	$17,000,000	$10,000,000	$1,800,000
Estimated Annual O & M Cost	$14,000	N/A	N/A	N/A
Total Estimated Present Worth Cost (30 yr)	$170,000	$17,000,000	$10,000,000	$1,800,000
USEPA ACCEPTANCE				
Regulatory agency acceptance will be documented in the ROD.				
COMMUNITY ACCEPTANCE				
Community acceptance will be documented in the ROD following public comment on the proposed plan.				

Table 8-18. *Alternative D1 Cost Estimate - No Action/Institutional Actions*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Land Use Restrictions	1	Lump Sum	$2,500	$2,500	
				Subtotal	$2,500
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$625
Engineering (15% Direct capital cost)					$375
Administration (5% Direct capital cost)					$125
TOTAL CAPITAL COST					**$3,625**
OPERATION & MAINTENANCE COSTS					
Ground Water Monitoring	1	Lump Sum	$13,750	$13,750	
PRESENT WORTH OPERATION & MAINTENANCE COST (7% for 30 yr)					**$170,624**
TOTAL PRESENT WORTH COST					**$174,249**
ROUNDED TO					**$170,000**

Table 8-19. *Alternative D2 Cost Estimate - Solid-phase Bioremediation with final placement in Impound 8.*

Item	Quantity	Unit	Unit Cost	Subtotal Cost	Total Cost
DIRECT CAPITAL COSTS					
Site Work					
Mobilization / Demobilization	1	Lump Sum	$3,000	$3,000	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	47,400	yd³	$17	$805,800	
Site Preparation	1	Lump Sum	$195,000	$195,000	
Bioremediation Unit Mob. / Demob.	1	Lump Sum	$150,000	$150,000	
Treatment					
Pretreatment Conditioning	124,600	yd³	$14	$1,744,400	
Biological Treatment Processing	124,600	yd³	$30	$3,738,000	
Chemical Analysis	1	Lump Sum	$330,000	$330,000	
Biological Analysis	1	Lump Sum	$85,000	$85,000	
Post-treatment Conditioning	140,175	Ton	$16	$2,242,800	
Material Strength Testing	1,752	Sample	$85	$148.936	
Air Control	53,325	Ton	$10	$533,250	
Final Material Placement					
Transportation to Impound 8	124,600	yd³	$5	$623,000	
Placement into Impound 8	124,600	yd³	$8	$996,000	
				Subtotal	$11,621,986
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$2,905.496
Engineering (15% Direct capital cost)					$1,743,298
Administration (5% Direct capital cost)					$581,099
TOTAL CAPITAL COST					$16,851,880
TOTAL PRESENT WORTH COST					$16,851,880
ROUNDED TO					$17,000,000

Table 8-20. *Alternative D3 Cost Estimate - Off-site disposal*

Item	Quantity	Unit	Unit Cost	Subtotal Cost	Total Cost
DIRECT CAPITAL COSTS					
Site Work					
Mobilization / Demobilization	1	Lump Sum	$150,000	$1,500	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	47,400	yd^3	$9	$426,600	
Transportation and Disposal					
Chemical Analysis (TCLP)	200	Sample	$750	$150,000	
Transportation to off-site landfill	2,000	Truck	$325	$650,000	
Transportation into off-site landfill	59,000	yd^3	$100	$5,900,000	
				Subtotal	$7,154,100
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$1,788,525
Engineering (15% Direct capital cost)					$1,073,114
Administration (5% Direct capital cost)					$357,705
TOTAL CAPITAL COST					$10,373,445
TOTAL PRESENT WORTH COST					$10,373,445
ROUNDED TO					$10,000,000

Notes:
1) One TCLP sample per 10 trucks will be required.
2) Material will be accepted at a landfill within 100 miles of the site.
3) Large debris will be handled as part of material category E.
4) Material will be accepted at a non-hazardous disposal facility.

Table 8-21. *Alternative D4 Cost Estimate - Consolidation in Impound 8*

Item	Quantity	Unit	Unit Cost	Subtotal Cost	Total Cost
DIRECT CAPITAL COSTS					
Site Work					
Mobilization / Demobilization	1	Lump Sum	$1,400	$1,400	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	47,400	yd^3	$9	$426,600	
Conditioning					
Material Strength Testing	711	Sample	$85	$60,435	
Final Material Placement					
Transportation to Impound 8	56,880	yd^3	$5	$284,400	
Placement into Impound 8	56,880	yd^3	$8	$455,040	
				Subtotal	$1,253,875
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$313,469
Engineering (15% Direct capital cost)					$188,081
Administration (5% Direct capital cost)					$62,694
TOTAL CAPITAL COST					$1,818,119
TOTAL PRESENT WORTH COST					$1,818,119
ROUNDED TO					$1,800,000

Table 8-22. *Detailed Analysis of Alternatives - Category E: General Plant Debris*

	Alternative E1 **No Action**	**Alternative E2** **Consolidation into Impound 8**
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Protection of Human Health	No action protective of human health with respect to general plant debris.	Removal and containment of general plant debris in Impound 8 would be protective of human health.
Protection of Environment	No action protective of the environment with respect to general plant debris.	Removal and containment of general plant debris in Impound 8 would be protective of human health.
COMPLIANCE WITH ARARS		
Chemical-specific ARARs	General plant debris is not expected to be currently causing an exceedence of ground water or surface water ARARs.	General plant debris is not expected to be currently causing an exceedence of ground water or surface water ARARs.
Location-specific ARARs	None.	Remedial actions would be conducted in accordance with floodplain requirements.
Action-specific ARARs	None.	Remedial activities would be conducted in accordance with the ACO, NJDEP site remediation regulations, OSHA, and NJ Soil Erosion and Sediment Control Act requirements. Transport of material to Impound 8 would be conducted according to NJ transportation requirements.
LONG TERM EFFECTIVENESS AND PERMANENCE		
Magnitude of Residual Risk	No residual risks associated with general plant debris.	No residual risk associated with containment of general plant debris in the Impound 8 facility.
Adequacy and Reliability of Controls	No action is adequate and reliable for general plant debris.	Impound 8 containment is an adequate and reliable control.

Table 8-22. ***Detailed Analysis of Alternatives - Category E: General Plant Debris***

	Alternative E1 **No Action**	**Alternative E2** **Consolidation into Impound 8**
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT		
Treatment Process Used and Materials Treated	No treatment.	No treatment.
Amount of Hazardous Material Destroyed or Treated	No treatment.	No treatment.
Degree of Expected Reduction of Toxicity, Mobility or Volume	No constituent mobility or toxicity associated with general plant debris.	No constituent toxicity or mobility associated with general plant debris.
Degree to Which Treatment is Irreversible	No treatment.	No treatment.
Type and Quantity of Residuals Remaining After Treatment	No treatment.	No treatment.
SHORT-TERM EFFECTIVENESS		
Protection of Community During Remedial Actions	Community is restricted from access to the Group III Impoundments.	Community is restricted from access to the Group III Impoundments. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of general plant debris.
Protection of Workers During Remedial Actions	No remedial actions	Appropriate protective equipment would be utilized during remedial activities.
Environmental Impacts	No anticipated environmental impacts.	No anticipated environmental impacts.
Time Until RAOs Are Achieved	General plant debris not addressed by RAOs.	General plant debris not addressed by RAOs.

Table 8-22. ***Detailed Analysis of Alternatives - Category E: General Plant Debris***

	Alternative E1 **No Action**	**Alternative E2** **Consolidation into Impound 8**
	IMPLEMENTABILITY	
Ability to Construct and Operate the Technology	No technology.	Placement in Impound 8 would be readily implemented.
Reliability of Technology	No technology.	Placement in Impound 8 reliable for long-term residual containment.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented, if necessary.	Additional remedial actions readily implemented, if necessary.
Ability to Monitor Effectiveness of Remedy	Effectiveness monitoring not required for general plant debris.	Effectiveness monitoring not required for general plant debris.
Coordination With Other Agencies	None required.	None required.
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities, If Necessary	None required.	None required.
Avaialability of Necessary Equipment, Specialist and Materials	None required.	None required.
Availability of Prospective Technologies	None required.	None required.

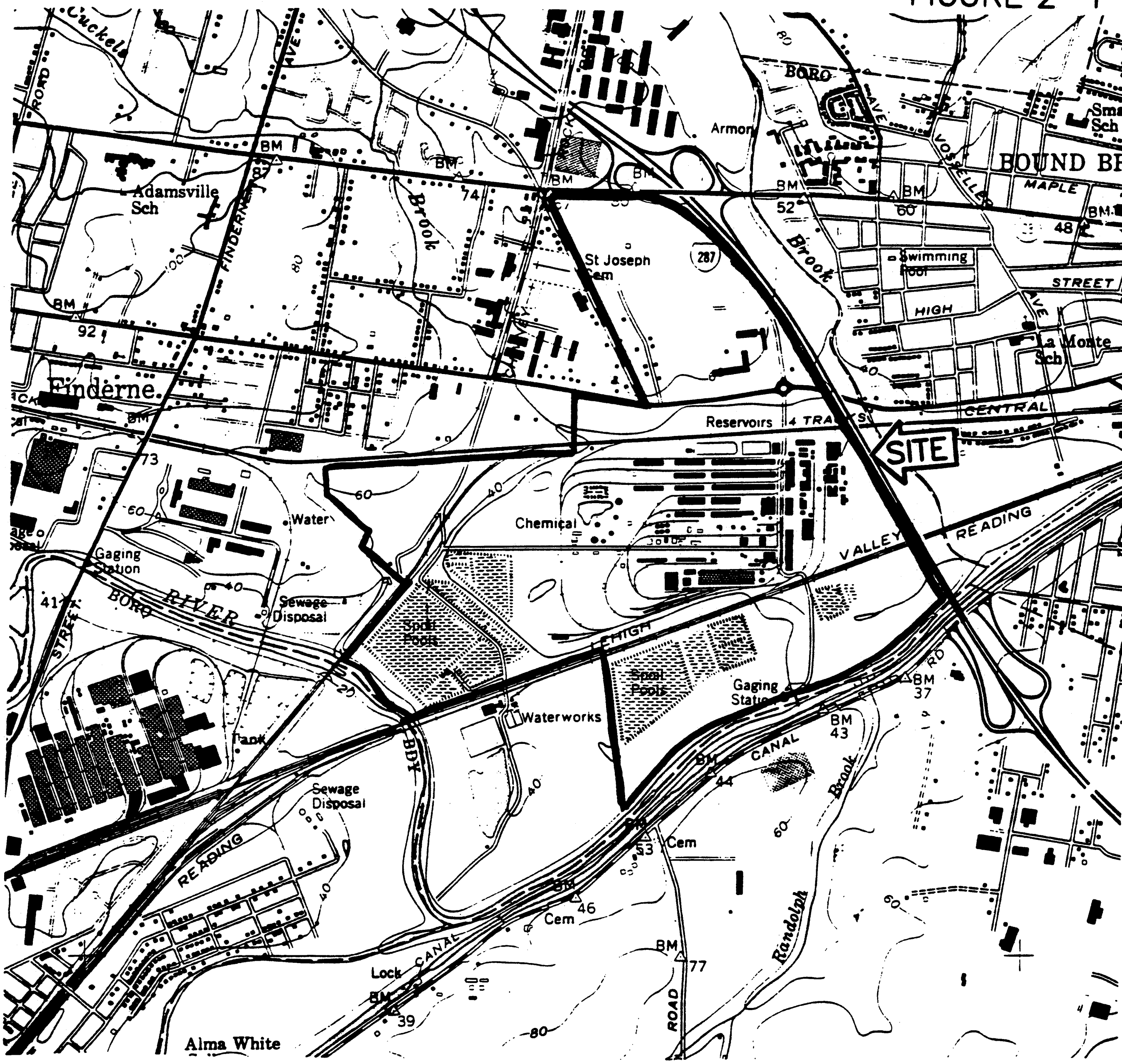
Table 8-22. ***Detailed Analysis of Alternatives - Category E: General Plant Debris***

	Alternative E1 **No Action**	**Alternative E2** **Consolidation into Impound 8**
	COST	
Total Estimated Capital Costs	N/A	$800,000
Estimated Annual O & M Cost	N/A	$0
Total Estimated Present Worth Cost (30 yr)	N/A	$800,000
USEPA ACCEPTANCE		
Regulatory agency acceptance will be documented in the ROD.		
COMMUNITY ACCEPTANCE		
Community acceptance will be documented in the ROD following public comment on the proposed plan.		

Table 8-23. *Alternative E2 Cost Estimate - Consolidation in Impound 8*

Item	Quantity	Unit	Unit Cost	Subtotal Cost	Total Cost
DIRECT CAPITAL COSTS					
Site Work					
Mobilization / Demobilization	1	Lump Sum	$2,700	$2,700	
Excavation	15,200	yd^3	$10	$152,000	
Debris Separation	15,200	yd^3	$15	$228,000	
Final Material Placement					
Transportation to off-site landfill	15,200	yd^3	$5	$76,000	
Transportation into off-site landfill	15,200	yd^3	$8	$121,600	
				Subtotal	$580,300
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$145,075
Engineering (15% Direct capital cost)					$87,045
Administration (5% Direct capital cost)					$29,015
TOTAL CAPITAL COST					$841,435
TOTAL PRESENT WORTH COST					$841,435
ROUNDED TO					$800,000

FIGURE 2-1

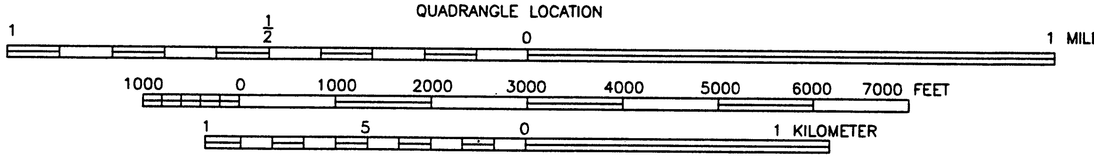


SITE LOCATION MAP

AMERICAN CYANAMID COMPANY
BOUND BROOK, NEW JERSEY

THIS MAP TAKEN FROM THE
BOUND BROOK, NEW JERSEY
USGS QUADRANGLE


QUADRANGLE LOCATION



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9/96 APG

OBRIEN & GERE ENGINEERS, INC.

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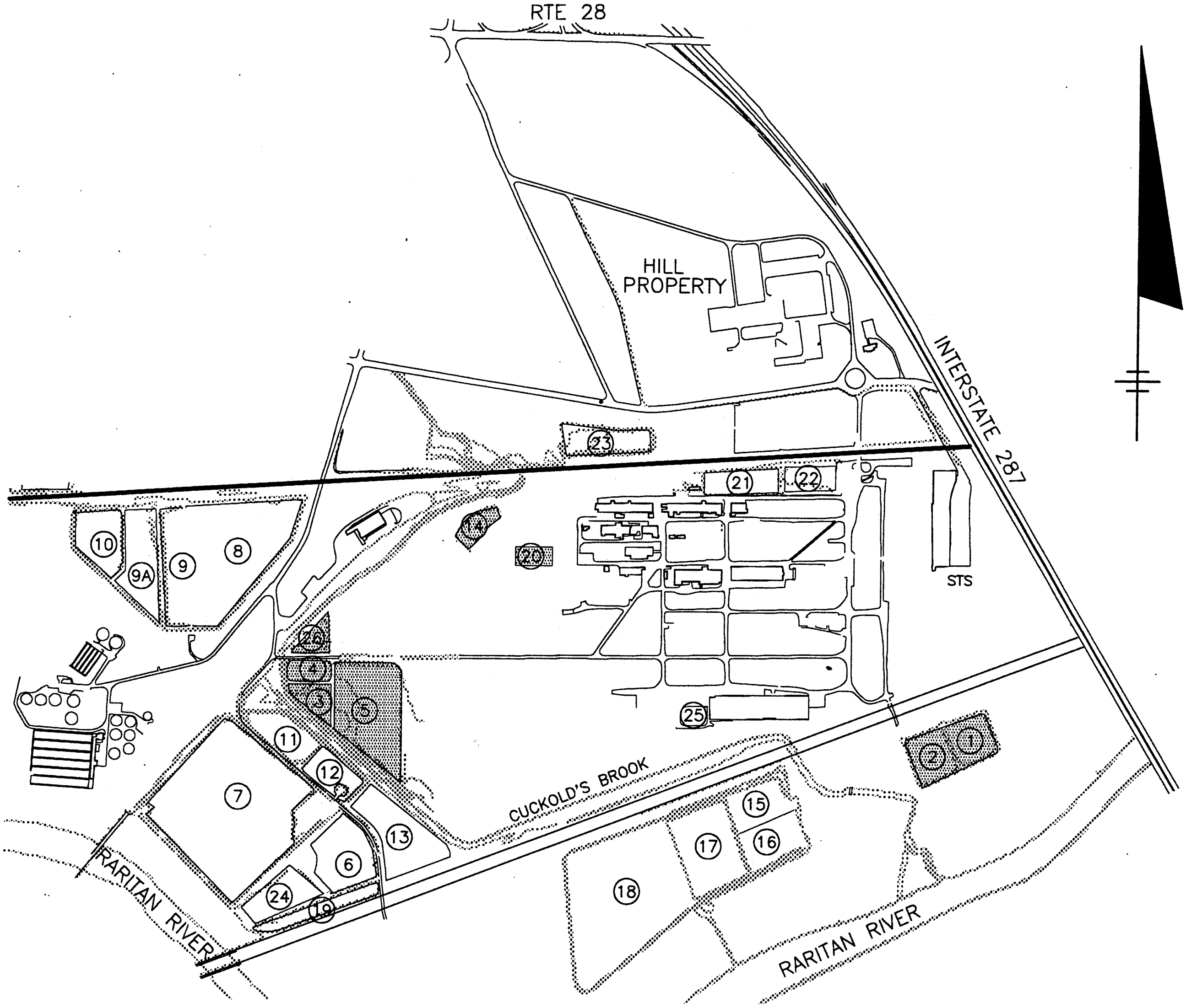
FIGURE 2-2



AMERICAN CYANAMID COMPANY

GROUP III IMPOUNDMENTS

NOT TO SCALE

11/06/97

FILE No. 5772.013-214

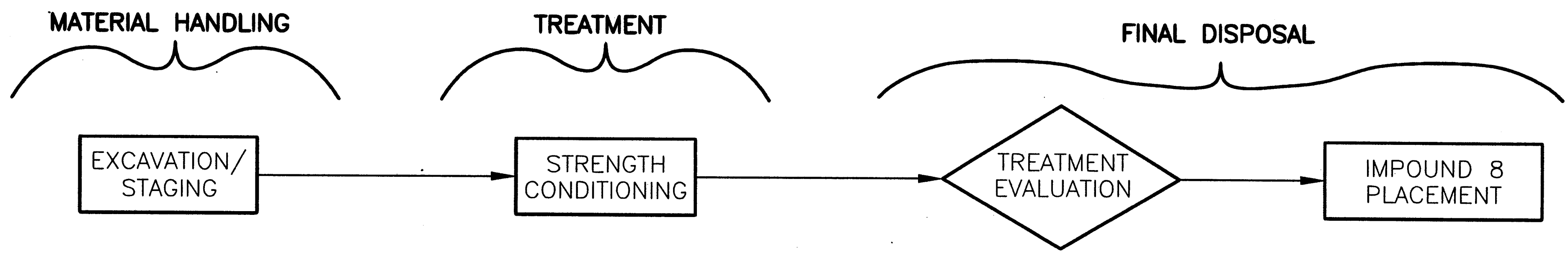
O'BRIEN & GERE ENGINEERS, INC.

5772213-1

CONSOLIDATION IN IMPOUNDMENT 8

CONCEPTUAL TREATMENT TRAIN

GROUP III IMPOUNDMENTS CMS/FS
AMERICAN CYANAMID BOUND BROOK SITE



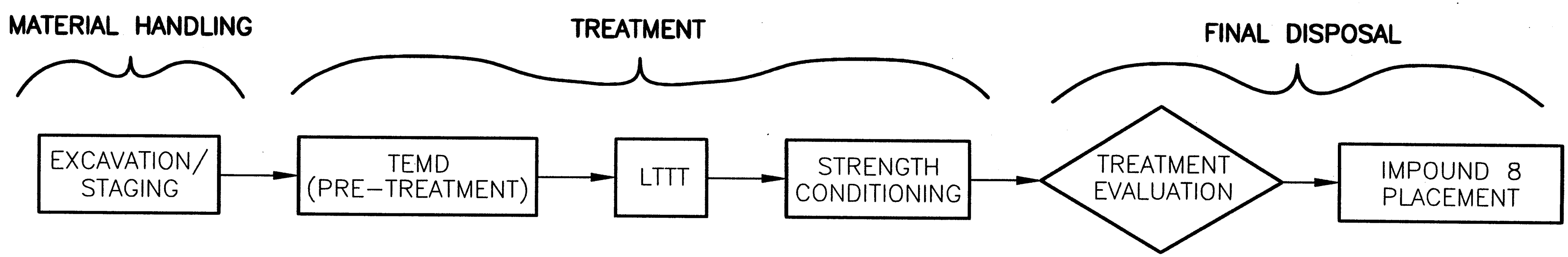
FILE NO. 5772.010-95F

FIGURE 6-1

O'BRIEN & GERE ENGINEERS, INC.

LTTT CONCEPTUAL TREATMENT TRAIN

GROUP III IMPOUNDMENTS CMS/FS
AMERICAN CYANAMID BOUND BROOK SITE



LTTT = LOW TEMPERATURE THERMAL TREATMENT

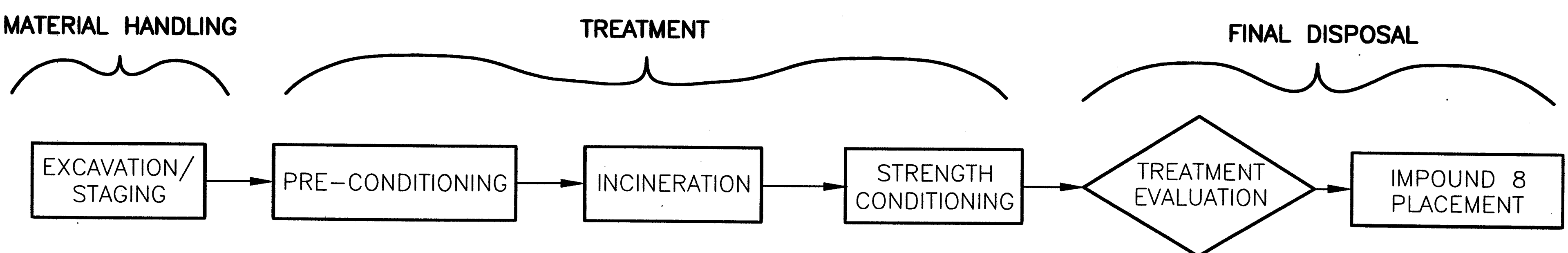
TEMD = THERMALLY ENHANCED MECHANICAL DESORPTION

FIGURE 6-2

FILE NO. 5772.010-92F

INCINERATION CONCEPTUAL TREATMENT TRAIN

GROUP III IMPOUNDMENTS CMS/FS
AMERICAN CYANAMID BOUND BROOK SITE



FILE NO. 5772.010-93F

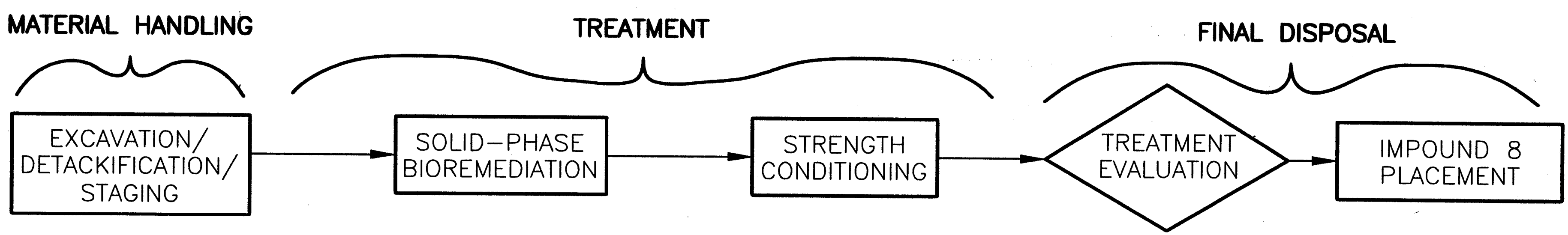
FIGURE 6-3

O'BRIEN & GERE ENGINEERS, INC.

SOLID PHASE BIOREMEDIATION

CONCEPTUAL TREATMENT TRAIN

GROUP III IMPOUNDMENTS CMS/FS
AMERICAN CYANAMID BOUND BROOK SITE



FILE NO. 5772.010-94F

FIGURE 6-4

O'BRIEN & GERE ENGINEERS, INC.

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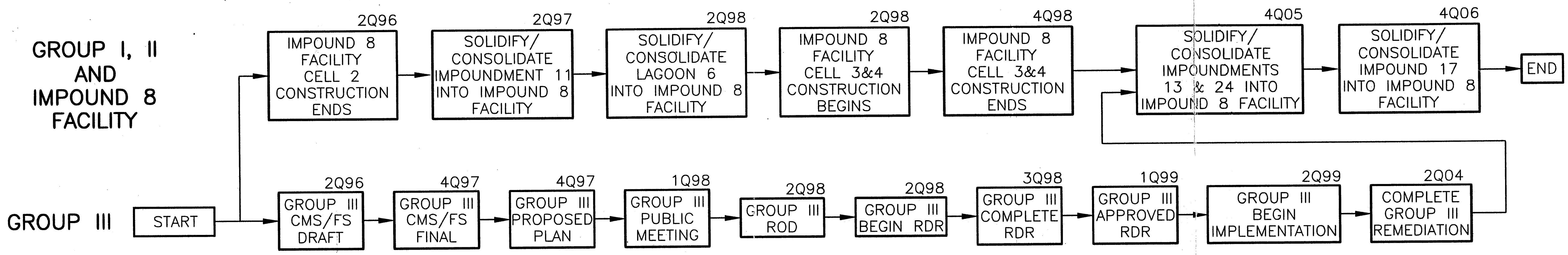

DRAWING NOTES:

1. SCHEDULE BASED ON ASSUMED REGULATORY APPROVAL PERIODS FOR DOCUMENTS REQUIRING AGENCY REVIEW INCLUDING REPORTS AND PERMITS.

2. SCHEDULE ESTIMATED ON A QUARTERLY BASIS.

3. GROUP I AND II WORK SHOWN MAY IMPACT GROUP III WORK, AND VICE-VERSA.

LEGEND

3Q97 ← ACTIVITY TO BE COMPLETED BY QUARTER OF YEAR

ACTIVITY

NO.	DATE	REVISION	INIT.
2	11/06/97	UPDATE SCHEDULE	
1	6/25/97	UPDATE SCHEDULE	
0	4/30/96	ISSUE	

AMERICAN HOME PRODUCTS CORPORATION
MADISON, NEW JERSEY

BOUND BROOK REMEDIAL PROGRAM
GROUP III CMS/FS REPORT

QUARTERLY MILESTONE SCHEDULE

In charge of ANGELO J. CARACCIOLO, III File no. 5772.013-216

Designed by AJC Checked by GAA Drawn by BET

NOT TO SCALE

This drawing was prepared at the scale indicated in the title block. Inaccuracies in the stated scale may be introduced when drawings are reproduced by any means. Use the graphic scale bar in the title block to determine the actual scale of this drawing.

O'BRIEN & GERE ENGINEERS, INC.

DATE: 11/06/97

FIGURE: 9-2

APPENDIX A

Impoundment 1 and 2 predesign testing report (bound separately as volume 2 of 4)

APPENDIX B

Solid phase biotreatment field pilot test report (bound separately as volume 3 of 4)

APPENDIX C

Compounds of concern analysis

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Totals

Compounds	Location by Impoundment	Mass (lb)	% of Total Mass
Naphthalene	1,2,3,4,5,14,20 & 26	40,911,656	74.71%
Benzene	1,2,3,4,5,14, 20 & 26	5,912,818	10.80%
2-Methylnaphthalene	1,2,3,4,5,14 & 26	1,652,332	3.02%
Toluene	1,2,3,4,5,14,20 & 26	1,603,024	2.93%
Xylenes (Total)	1,2,3,4,5,14,20 & 26	773,267	1.41%
1,2-Dichlorobenzene	1,2,3,4,5,14,20 & 26	771,921	1.41%
N-Nitrosodiphenylamine	3,5,14,20 & 26	697,175	1.27%
Nitrobenzene	1,2,3,5,14 & 26	430,970	0.79%
Fluorene	2,3,4,5 & 14	274,476	0.49%
Dibenzofuran	1,2,3,4,5 & 14	254,405	0.46%
Acenaphthene	1,2,4,5 & 26	244,320	0.45%
Phenanthrene	1,2,3,4,5,14 & 26	234,392	0.43%
Chloroform	1 & 5	130,968	0.24%
Carbazole	5 & 14	106,155	0.19%
Chlorobenzene	5,14,20 & 26	102,707	0.19%
1,4-Dichlorobenzene	1,2,3,4,5,20 & 26	93,954	0.17%
Anthracene	4,5 &14	92,610	0.17%
Benzo(a)anthracene	4,5,14 & 26	80,677	0.15%
Phenol	1,2,3,5 & 20	62,942	0.11%
Benzoic acid	1 & 2	55,249	0.10%
Ethylbenzene	1,4,5,14,20 & 26	51,768	0.09%
Fluoroanthene	1,2,4,5 & 26	44,769	0.08%
Pyrene	1,3,4,5 & 26	31,473	0.06%
Dimethylphthalate	14 & 26	30,675	0.06%
1,2,4-Trichlorobenzene	3,4,14 & 26	30,593	0.06%
2-Chloronaphthalene	1,2,14 & 26	27,058	0.05%
4 - Nitroaniline	5	22,911	0.04%
1,3-Dichlorobenzene	2,3 & 4	11,340	0.02%
Acenaphthylene	3 &4	8,824	0.02%
2,4 - Dimethylphenol	1,2 & 14	2,677	<.01%
3&4 - Methylphenol	1 & 14	2,553	<.01%
2,4-Dinitrotoluene	3	2,309	<.01%
2-Methyl Phenol	2 & 3	2,215	<.01%
Chloromethane	1	2,179	<.01%
Carbon Disulfide	1	1,692	<.01%
4 - Chloroaniline	20	380	<.01%
Bis(2-ethylhexyl)phthalate	26	131	<.01%
3 - Nitroaniline	20	63	<.01%
Chrysene	4	2	<.01%
Di-n-butylphthalate	4	1	<.01%
		54,759,631	100.00%

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 1 (1MIX-1)

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	38700	19,500	1954	1,474,586	94.9%	88.6%
Carbon Disulfide	44.4	19,500	1954	1692	0.1%	0.1%
Chloroform	1.26	19,500	1954	48	0.0%	0.0%
Chloromethane	57.2	19,500	1954	2179	0.1%	0.1%
Ethylbenzene	114	19,500	1954	4344	0.3%	0.3%
Toluene	101	19,500	1954	3848	0.2%	0.2%
Xylenes (Total)	1760	19,500	1954	67,061	4.3%	4.0%
Subtotal:				1,553,759		
SVOCs						
Acenaphthene	10.2	19,500	1954	389	0.4%	0.0%
Benzoic Acid	362	19,500	1954	13,793	12.5%	0.8%
2-Chloronaphthalene	101	19,500	1954	3848	3.5%	0.2%
Dibenzofuran	35.8	19,500	1954	1364	1.2%	0.1%
1,2-Dichlorobenzene	310	19,500	1954	11,812	10.7%	0.7%
1,4-Dichlorobenzene	38.6	19,500	1954	1471	1.3%	0.1%
2,4-Dimethylphenol	11.7	19,500	1954	446	0.4%	0.0%
Fluoranthene	10.4	19,500	1954	396	0.4%	0.0%
2-Methylnaphthalene	169	19,500	1954	6439	5.8%	0.4%
3&4-Methylphenol	16.6	19,500	1954	633	0.6%	0.0%
Naphthalene	1390	19,500	1954	52,963	48.0%	3.2%
Nitrobenzene	365	19,500	1954	13,908	12.6%	0.8%
Phenanthrene	27.9	19,500	1954	1063	1.0%	0.1%
Phenol	35.3	19,500	1954	1345	1.2%	0.1%
Pyrene	11.6	19,500	1954	442	0.4%	0.0%
Subtotal:				110,312		
Total:				1,664,071		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 2 (2HC-1)

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	33,000	24,000	1954	1,547,568	84.2%	73.2%
Toluene	5660	24,000	1954	265,431	14.4%	12.6%
Xylenes (Total)	529	24,000	1954	24,808	1.3%	1.2%
Subtotal:				1,837,807		
SVOCs						
Acenaphthene	40.6	24,000	1954	1904	0.7%	0.1%
Benzoic Acid	271	24,000	1954	12,709	4.6%	0.6%
Dibenzofuran	19.9	24,000	1954	933	0.3%	0.0%
1,2-Dichlorobenzene	1020	24,000	1954	47,834	17.3%	2.3%
1,3-Dichlorobenzene	32.7	24,000	1954	1533	0.6%	0.1%
1,4-Dichlorobenzene	183	24,000	1954	8582	3.1%	0.4%
Fluorene	473	24,000	1954	22,182	8.0%	1.0%
2-Methylnaphthalene	269	24,000	1954	12,615	4.6%	0.6%
Naphthalene	3460	24,000	1954	162,260	58.6%	7.7%
Nitrobenzene	99.5	24,000	1954	4666	1.7%	0.2%
Phenanthrene	32.7	24,000	1954	1533	0.6%	0.1%
Subtotal:				276,752		
Total:				2,114,559		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 2 (2MIX-1)

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	43,400	24,000	1954	2,035,286	81.8%	71.3%
Toluene	8780	24,000	1954	411,747	16.5%	14.4%
Xylenes (Total)	874	24,000	1954	40,987	1.6%	1.4%
Subtotal:				2,488,020		
SVOCs						
Acenaphthene	68.2	24,000	1954	3198	0.9%	0.1%
Benzoic Acid	884	24,000	1954	41,456	11.3%	1.5%
1,2-Dichlorobenzene	1000	24,000	1954	46,896	12.8%	1.6%
1,3-Dichlorobenzene	36.7	24,000	1954	1721	0.5%	0.1%
1,4-Dichlorobenzene	211	24,000	1954	9895	2.7%	0.3%
2,4-Dimethylphenol	27.1	24,000	1954	1271	0.3%	0.0%
Fluorene	345	24,000	1954	16,179	4.4%	0.6%
2-Methylnaphthalene	430	24,000	1954	20,165	5.5%	0.7%
2-Methylphenol	14.4	24,000	1954	675	0.2%	0.0%
Naphthalene	4740	24,000	1954	222,287	60.5%	7.8%
Phenanthrene	64.2	24,000	1954	3011	0.8%	0.1%
Phenol	15.2	24,000	1954	713	0.2%	0.0%
Subtotal:				367,468		
Total:				2,855,488		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 2 (2VR-1)

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	61,000	24,000	1954	2,860,656	75.6%	61.8%
Toluene	16,200	24,000	1954	759,715	20.1%	16.4%
Xylenes (Total)	3440	24,000	1954	161,322	4.3%	3.5%
Subtotal:				3,781,693		
SVOCs						
Acenaphthene	314	24,000	1954	14,725	1.7%	0.3%
Benzoic Acid	861	24,000	1954	40,377	4.8%	0.9%
2-Chloronaphthalene	378	24,000	1954	17,727	2.1%	0.4%
Dibenzofuran	247	24,000	1954	11,583	1.4%	0.3%
1,2-Dichlorobenzene	2210	24,000	1954	103,640	12.2%	2.2%
1,3-Dichlorobenzene	115	24,000	1954	5393	0.6%	0.1%
1,4-Dichlorobenzene	588	24,000	1954	27,575	3.3%	0.6%
Fluoranthene	37	24,000	1954	1735	0.2%	0.0%
Fluorene	376	24,000	1954	17,633	2.1%	0.4%
2-Methylnaphthalene	1520	24,000	1954	71,282	8.4%	1.5%
Naphthalene	9860	24,000	1954	462,395	54.6%	10.0%
Nitrobenzene	1330	24,000	1954	62,372	7.4%	1.3%
Phenanthrene	184	24,000	1954	8629	1.0%	0.2%
Phenol	38.2	24,000	1954	1791	0.2%	0.0%
Subtotal:				846,857		
Total:				4,628,551		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 3

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	36,000	16,800	2182	1,319,674	75.9%	40.4%
Toluene	9100	16,800	2182	333,584	19.2%	10.2%
Xylenes (Total)	2300	16,800	2182	84,312	4.9%	2.6%
Subtotal:				1,737,570		
SVOCs						
Acenaphthylene	240	16,800	2182	8798	0.6%	0.3%
Dibenzofuran	150	16,800	2182	5499	0.4%	0.2%
1,2-Dichlorobenzene	11,000	16,800	2182	403,234	26.3%	12.3%
1,3-Dichlorobenzene	160	16,800	2182	5865	0.4%	0.2%
1,4-Dichlorobenzene	850	16,800	2182	31,159	2.0%	1.0%
2,4-Dinitrotoluene	63	16,800	2182	2309	0.2%	0.1%
Fluorene	2800	16,800	2182	102,641	6.7%	3.1%
2-Methylnaphthalene	1300	16,800	2182	47,655	3.1%	1.5%
2-Methyl phenol	42	16,800	2182	1540	0.1%	0.0%
Naphthalene	24,000	16,800	2182	879,782	57.4%	26.9%
Nitrobenzene	500	16,800	2182	18,329	1.2%	0.6%
N-Nitrosodiphenylamine	150	16,800	2182	5499	0.4%	0.2%
Phenanthrene	240	16,800	2182	8798	0.6%	0.3%
Phenol	200	16,800	2182	7332	0.5%	0.2%
Pyrene	40	16,800	2182	1466	0.1%	0.0%
1,2,4-Trichlorobenzene	70	16,800	2182	2566	0	0.1%
Subtotal:				1,532,471		
Total:				3,270,041		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 4

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	21,000	900	2182	41,240	79.8%	68.1%
Ethylbenzene	1200	900	2182	2357	4.6%	3.9%
Toluene	3100	900	2182	6088	11.8%	10.0%
Xylenes (Total)	1000	900	2182	1964	3.8%	3.2%
Subtotal:				51,648		
SVOCs						
Acenaphthene	19	900	2182	37	0.4%	0.1%
Acenaphthylene	13	900	2182	26	0.3%	0.0%
Anthracene	3.2	900	2182	6	0.1%	0.0%
Benzo(a)anthracene	1.1	900	2182	2	0.0%	0.0%
Chrysene	0.89	900	2182	2	0.0%	0.0%
Dibenzofuran	21	900	2182	41	0.5%	0.1%
1,2-Dichlorobenzene	1700	900	2182	3338	37.4%	5.5%
1,3-Dichlorobenzene	42	900	2182	82	0.9%	0.1%
1,4-Dichlorobenzene	240	900	2182	471	5.3%	0.8%
Di-n-butylphthalate	0.54	900	2182	1	0.0%	0.0%
Fluoranthene	3	900	2182	6	0.1%	0.0%
Fluorene	350	900	2182	687	7.7%	1.1%
2-Methylnaphthalene	130	900	2182	255	2.9%	0.4%
Naphthalene	2000	900	2182	3928	43.9%	6.5%
Phenanthrene	16	900	2182	31	0.4%	0.1%
Pyrene	2.5	900	2182	5	0.1%	0.0%
1,2,4-Trichlorobenzene	9.1	900	2182	18	0.2%	0.0%
Subtotal:				8938		
Total:				60,586		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 5

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	780	75,000	2182	127,647	11.1%	0.3%
Chlorobenzene	96	75,000	2182	15,710	1.4%	0.0%
Chloroform	800	75,000	2182	130,920	11.4%	0.3%
Ethylbenzene	170	75,000	2182	27,821	2.4%	0.1%
Toluene	3000	75,000	2182	490,950	42.6%	1.1%
Xylenes (Total)	2200	75,000	2182	360,030	31.2%	0.8%
Subtotal:				1,153,078		
SVOCs						
Acenaphthene	1400	75,000	2182	229,110	0.5%	0.5%
Anthracene	560	75,000	2182	91,644	0.2%	0.2%
Benzo(a)anthracene	360	75,000	2182	58,914	0.1%	0.1%
Carbazole	590	75,000	2182	96,554	0.2%	0.2%
Dibenzofuran	1400	75,000	2182	229,110	0.5%	0.5%
1,2-Dichlorobenzene	1500	75,000	2182	245,475	0.6%	0.6%
1,4-Dichlorobenzene	200	75,000	2182	32,730	0.1%	0.1%
Fluoranthene	260	75,000	2182	42,549	0.1%	0.1%
Fluorene	890	75,000	2182	145,649	0.3%	0.3%
2-Methylnaphthalene	9200	75,000	2182	1,505,580	3.5%	3.4%
Naphthalene	240,000	75,000	2182	39,276,000	91.3%	88.9%
4-Nitroaniline	140	75,000	2182	22,911	0.1%	0.1%
Nitrobenzene	1600	75,000	2182	261,840	0.6%	0.6%
N-Nitrosodiphenylamine	3100	75,000	2182	507,315	1.2%	1.1%
Phenanthrene	1300	75,000	2182	212,745	0.5%	0.5%
Phenol	320	75,000	2182	52,368	0.1%	0.1%
Pyrene	180	75,000	2182	29,457	0.1%	0.1%
Subtotal:				43,039,950		
Total:				44,193,028		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 14

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	350	4000	2182	3055	8.2%	0.5%
Chlorobenzene	2200	4000	2182	19,202	51.3%	3.0%
Ethylbenzene	75	4000	2182	655	1.8%	0.1%
Toluene	820	4000	2182	7157	19.1%	1.1%
Xylenes (Total)	840	4000	2182	7332	19.6%	1.1%
Subtotal:				37,399		
SVOCs						
Anthracene	110	4000	2182	960	0.2%	0.1%
Benzo(a)anthracene	270	4000	2182	2357	0.4%	0.4%
Carbazole	1100	4000	2182	9601	1.6%	1.5%
2-Chloronaphthalene	600	4000	2182	5237	0.9%	0.8%
Dibenzofuran	780	4000	2182	6808	1.1%	1.1%
1,2-Dichlorobenzene	130	4000	2182	1135	0.2%	0.2%
2,4-Dimethylphenol	110	4000	2182	960	0.2%	0.1%
Dimethylphthalate	3500	4000	2182	30,548	5.0%	4.7%
Fluorene	380	4000	2182	3317	0.5%	0.5%
2-Methylnaphthalene	2400	4000	2182	20947	3.4%	3.2%
4-Methylphenol	220	4000	2182	1920	0.3%	0.3%
Naphthalene	27,000	4000	2182	235,656	38.8%	36.5%
Nitrobenzene	8500	4000	2182	74,188	12.2%	11.5%
N-Nitrosodiphenylamine	21,000	4000	2182	183,288	30.2%	28.4%
Phenanthrene	340	4000	2182	2968	0.5%	0.5%
1,2,4-Trichlorobenzene	3200	4000	2182	27,930	4.6%	4.3%
Subtotal:				607,818		
Total:				645,217		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 20

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	5200	7800	2119	85,947	32.7%	32.6%
Chlorobenzene	4100	7800	2119	67,766	25.8%	25.7%
Ethylbenzene	1000	7800	2119	16,528	6.3%	6.3%
Toluene	86	7800	2119	1421	0.5%	0.5%
Xylenes (Total)	5500	7800	2119	90,905	34.6%	34.5%
Subtotal:				262,567		
SVOCs						
4-Chloroaniline	23	7800	2119	380	33.9%	0.1%
1,2-Dichlorobenzene	9.6	7800	2119	159	14.1%	0.1%
1,4-Dichlorobenzene	4.4	7800	2119	73	6.5%	0.0%
Naphthalene	3.7	7800	2119	61	5.4%	0.0%
3-Nitroaniline	3.8	7800	2119	63	5.6%	0.0%
N-Nitrosodiphenylamine	17	7800	2119	281	25.0%	0.1%
Phenol	6.4	7800	2119	106	9.4%	0.0%
Subtotal:				1122		
Total:				263,689		

AMERICAN HOME PRODUCTS CORPORATION
GROUP III IMPOUNDMENTS
Detected Compounds
Impoundment 26

Compound of Concern	Conc. (ppm)	Volume (yd3)	Density (lb/yd3)	Mass (lb)	% of Subtotal	% of Total
VOCs						
Benzene	0.32	17,600	2250	13	1.8%	0.0%
Chlorobenzene	0.73	17,600	2250	29	4.1%	0.1%
Ethylbenzene	1.6	17,600	2250	63	9.0%	0.2%
Toluene	6.6	17,600	2250	261	37.0%	1.0%
Xylenes (Total)	8.6	17,600	2250	341	48.2%	1.3%
Subtotal:				707		
SVOCs						
Acenaphthene	1.5	17,600	2250	59	0.2%	0.2%
Benzo(a)anthracene	490	17,600	2250	19,404	74.2%	72.2%
Bis(2-ethylhexyl)phthalate	3.3	17,600	2250	131	0.5%	0.5%
2-Chloronaphthalene	6.2	17,600	2250	246	0.9%	0.9%
1,2-Dichlorobenzene	79	17,600	2250	3128	12.0%	11.6%
1,4-Dichlorobenzene	12	17,600	2250	475	1.8%	1.8%
Dimethylphthalate	3.2	17,600	2250	127	0.5%	0.5%
Fluoranthene	2.1	17,600	2250	83	0.3%	0.3%
2-Methylnaphthalene	4.4	17,600	2250	174	0.7%	0.6%
Naphthalene	22	17,600	2250	871	3.3%	3.2%
Nitrobenzene	8.4	17,600	2250	333	1.3%	1.2%
N-Nitrosodiphenylamine	20	17,600	2250	792	3.0%	2.9%
Phenanthrene	4	17,600	2250	158	0.6%	0.6%
Pyrene	2.6	17,600	2250	103	0.4%	0.4%
1,2,4-Trichlorobenzene	2	17,600	2250	79	0.3%	0.3%
Subtotal:				26,164		
Total:				26,871		

APPENDIX D

Solid phase biotreatment analytical results

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Bioremediation Summary - 3 Weeks Operating Conditions

	Impoundment 4		Impoundment 5		Impoundment 14		Impoundment 20		Impoundment 26	
Compound of Concern	Raw Mat'l (ppm)	Treated Mat'l (ppm)	Raw Mat'l (ppm)	Treated Mat'l (ppm)	Raw Mat'l (ppm)	Treated Mat'l (ppm)	Raw Mat'l (ppm)	Treated Mat'l (ppm)	Raw Mat'l (ppm)	Treated Mat'l (ppm)
Benzene	21,000	12	780	5.43	350	1.8	5200	3.6	0.32	0.0024
Toluene	3100	10	3000	30.8	820	4.7	86	0.48	7	0.0156
Xylenes	1000	13	2200	54	840	10	5500	193	9	0.0424
Naphthalene	2000	775	240,000	10,100	27,000	6790	3.7	9.2	22	15
Nitrobenzene	<2.1	5.8	1600	248	8500	1850	<12	4.58	8.4	10
1,2-Dichlorobenzene	1700	151	1500	49.1	130	5.3	9.6	4.6	79	19
N-Nitrosodiphenylamine	<2.1	15	3100	1500	21,000	6390	17	25	20	11.1
2-Methylnaphthalene	130	104	9200	1040	2,400	476	<12	<2.2	4.4	6.01

NOTES:
1.) MDL shown as 1/2 MDL presented in lab data based on NJDEP requirements
2.) Shaded values represent highest level for compound of concern.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results Bioremediation Treatability Study - Impoundment 4

Compound of Concern	Raw Material	WK-3 (total / % reduction)		WK-6 (total / % reduction)		WK-9 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION	
										Total	%
VOCs											
Benzene	21,000	12	99.9%	1.8	99.99%	1.2	99.99%	5.00	99.98%	6.1	0.03%
Toluene	3100	10	99.7%	2.1	99.9%	0.76	99.98%	4.29	99.9%	5.0	0.2%
Xylenes	1000	13	98.7%	4.7	99.5%	1.2	99.9%	6.30	99.4%	6.1	0.6%
SVOCs											
2-Methylnaphthalene	130	104	20.0%	146	-	61	53.1%	104	20.3%	43	26.8%
Naphthalene	2000	775	61.3%	1630	18.5%	250	87.5%	885	55.8%	697	34.8%
Nitrobenzene	< 2.1	5.8	-	< 1.9	9.5%	4.42	-	4.67	-	2.0	-
1,2-Dichlorobenzene	1700	151	91.1%	242	85.8%	77.7	95.4%	157	90.8%	82	4.8%
N-Nitrosodiphenylamine	< 2.1	15	-	20.2	-	31.5	-	22.2	-	8.4	-

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 and 1996 treatability studies.
3) MDL shown as 1/2 MDL presented in lab data based on NJDEP requirements.
4) "-" Denotes value less than zero.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results Bioremediation Treatability Study - Impoundment 5

Compound of Concern	Raw Material	WK-3 (total / % reduction)		WK-6 (total / % reduction)		WK-9 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION	
										Total	%
VOCs											
Benzene	780	5.4	99.3%	2.38	99.7%	1.09	99.9%	2.96	99.6%	2.2	0.3%
Toluene	3000	30.8	99.0%	10	99.7%	2.84	99.9%	14.5	99.5%	14.5	0.5%
Xylenes	2200	54	97.5%	23	99.0%	3.63	99.8%	26.9	98.8%	25.4	1.2%
SVOCs											
Naphthalene	240,000	10,100	95.8%	15,900	93.4%	3360	98.6%	9790	95.9%	6280	2.6%
Nitrobenzene	1600	248	84.5%	266	83.4%	72	95.5%	195	87.8%	107	6.7%
1,2-Dichlorobenzene	1500	49	96.7%	113	92.5%	20	98.7%	60.7	96.0%	47.6	3.2%
N-Nitrosodiphenylamine	3100	1500	51.6%	967	68.8%	1050	66.1%	1170	62.3%	287	9.3%
2-Methylnaphthalene	9200	1040	88.7%	1020	88.9%	591	93.6%	884	90.4%	254	2.8%

Notes:
1) Data presented in mg/kg (ppm)
2) Data from O'Brien & Gere 1995 and 1996 treatability studies.
3) MDL shown as 1/2 MDL presented in lab data based on NJDEP requirements.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results Bioremediation Treatability Study - Impoundment 14

Compound of Concern	Raw Material	WK-3 (total / % reduction)		WK-6 (total / % reduction)		WK-9 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION	
										Total	%
VOCs											
Benzene	350	1.8	99.5%	3	99.1%	2	99.4%	2.27	99.4%	0.64	0.2%
Toluene	820	4.7	99.4%	6	99.3%	3	99.6%	4.57	99.4%	1.5	0.2%
Xylenes	840	10	98.8%	10	98.8%	2	99.8%	7.33	99.1%	4.6	0.5%
SVOCs											
Naphthalene	27,000	6790	74.9%	10,600	60.7%	2850	89.4%	6750	75.0%	3880	14.4%
Nitrobenzene	8500	1850	78.2%	3140	63.1%	2010	76.4%	2330	72.6%	703	8.3%
1,2-Dichlorobenzene	130	5.3	95.9%	13	90.0%	4.4	96.6%	7.57	94.2%	4.7	3.6%
N-Nitrosodiphenylamine	21,000	6390	69.6%	8800	58.1%	9300	55.7%	8160	61.1%	1560	7.4%
2-Methylnaphthalene	2400	476	80.2%	703	70.7%	309	87.1%	496	79.3%	198	8.2%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 and 1996 treatability studies.
3) MDL shown as 1/2 MDL presented in lab data based on NJDEP requirements.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results Bioremediation Treatability Study - Impoundment 20

Compound of Concern	Raw Material	WK-3 (total / % reduction)		WK-6 (total / % reduction)		WK-9 (total / % reduction)		AVERAGES (total /% reduction)		STANDARD DEVIATION Total	STANDARD DEVIATION %
VOCs											
Benzene	5200	3.6	99.9%	1.4	99.97%	0.6	99.99%	1.87	99.96%	1.6	0.03%
Toluene	86	0.48	99.4%	0.246	99.7%	0.19	99.8%	0.31	99.6%	0.2	0.2%
Xylenes	5500	193	96.5%	90.2	98.4%	51	99.1%	111	98.0%	73.3	1.3%
SVOCs											
Naphthalene	3.7	9.2	-	11	-	21	-	13.7	-	6.4	-
Nitrobenzene	< 12	76.8	-	42.9	-	< 2.15	82.1%	41.3	-	37.4	-
1,2-Dichlorobenzene	9.6	4.58	52.3%	1.4	85.4%	3.1	67.7%	3.03	68.5%	1.6	16.6%
N-Nitrosodiphenylamine	17	25	-	23	-	17.6	-	21.9	-	3.8	-
2-Methylnaphthalene	< 12	< 2.2	81.7%	< 2.2	81.7%	< 1.9	84.2%	2.10	82.5%	0.2	1.4%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 and 1996 treatability studies.
3) MDL shown as 1/2 MDL presented in lab data based on NJDEP requirements.
4) "-" Denotes value less than zero.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results Bioremediation Treatability Study - Impoundment 26

Compound of Concern	Raw Material	WK-3 (total / % reduction)		WK-6 (total / % reduction)		WK-9 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION Total	STANDARD DEVIATION %
VOCs											
Benzene	0.32	0.0024	99.3%	1.2	-	< 0.00052	99.99%	0.40	-	0.7	57.3%
Toluene	7	0.0156	99.8%	3.2	54.3%	0.008	99.9%	1.07	84.6%	1.8	26.3%
Xylenes	9	0.0424	99.5%	1.3	85.6%	0.007	99.9%	0.45	95.0%	0.7	8.2%
SVOCs											
Naphthalene	45	15	66.7%	23	-	10	77.8%	16.00	64.4%	6.6	42.1%
Nitrobenzene	21	10	-	4.47	78.7%	9	-	7.8	62.7%	2.9	45.4%
1,2-Dichlorobenzene	150	19	87.3%	12.2	91.9%	11.7	92.2%	14.3	90.5%	4.1	2.7%
N-Nitrosodiphenylamine	37	11.1	70.0%	6.61	82.1%	12.3	66.8%	10.0	73.0%	3.0	8.1%
2-Methylnaphthalene	4.4	6.01	-	6.15	-	3.42	22.3%	5.19	-	1.5	12.9%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 and 1996 treatability studies.
3) MDL shown as 1/2 MDL presented in lab data based on NJDEP requirements.
4) "-" Denotes value less than zero.

APPENDIX E

Low temperature thermal treatment analytical results

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

LTTT Summary
300/15 Operating Conditions

Compound of Concern	Raw Material (2HC-1)	2HC-1* (ppm)	2HC-1** (ppm)	Raw Material (2VR-1)	2VR-1* (ppm)	2VR-1** (ppm)
Benzene	33,000	1.77	0.449	61,000	0.0157	0.0734
Toluene	5660	2.72	4.54	16,200	0.0604	0.792
Xylenes	529	0.696	13.6	3440	0.0046	6.8
Naphthalene	3460	35.2	462	9860	5.2	839
Nitrobenzene	100	<0.75	8.63	1330	<0.025	65
1,2-Dichlorobenzene	1020	<0.75	97.1	2210	0.148	108
N-Nitrosodiphenylamine	<3.6	<0.36	<0.38	<5.5	<0.012	<0.35
2-Methylnaphthalene	269	6.06	61.2	1520	1	143

Compound of Concern	Raw Material (1MIX-1)	1MIX-1* (ppm)	1MIX-1** (ppm)	Raw Material (2MIX-1)	2MIX-1* (ppm)	2MIX-1** (ppm)
Benzene	38,700	0.118	4.84	43,400	0.66	1.19
Toluene	101	0.0408	19.3	8780	0.665	6.38
Xylenes	1760	0.0167	37.4	874	0.314	13.9
Naphthalene	1390	103	287	4740	78	666
Nitrobenzene	365	<0.60	26.3	<8.5	<0.65	24.8
1,2-Dichlorobenzene	310	6.1	45.2	1000	<0.65	86.9
N-Nitrosodiphenylamine	<0.85	<0.29	<0.39	<4.1	<0.31	<0.32
2-Methylnaphthalene	169	14.5	32.2	430	13.5	84.5

Denotes highest level

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 treatability studies.
3) Weston-1 data not included in average or standard deviation as temperature was less than 300 degrees F.
4) "NC" denotes value not calculated.
5) "*" Denotes SoilTech: 300/15.
6) "**" Denotes OBG Tech: 300/15.
7) "<" Denotes one half MDL value.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results LTTT Treatability Study - 2HC-1

Compound of Concern	Raw Material	WESTON-1 (233/16) (total / % reduction)		WESTON-2 (428/13) (total / % reduction)		WESTON-3 (546/16) (total / % reduction)		WESTON-4 (593/18) (total / % reduction)		SOILTECH: 600 F (total / % reduction)		SOILTECH: 800 F (total / % reduction)	
VOCs													
Benzene	33,000	128	99.61%	0.243	99.99%	1.04	99.99%	0.507	99.99%	0.395	99.99%	0.0463	99.99%
Toluene	5,660	158	97.21%	0.323	99.99%	2.03	99.96%	1.35	99.98%	3.88	99.93%	0.04	99.99%
Xylenes	529	117	77.88%	0.219	99.96%	1.11	99.79%	0.424	99.92%	0.222	99.96%	< 0.025	100.00%
SVOCs													
Naphthalene	3,460	1880	45.66%	45.7	98.68%	1.93	99.94%	0.885	99.97%	0.203	99.99%	< 0.55	99.98%
Nitrobenzene	100	< 1.5	98.49%	< 0.70	99.30%	< 0.75	99.25%	< 0.70	99.30%	< 0.46	99.54%	< 0.50	99.50%
1,2-Dichlorobenzene	1,020	261	74.41%	1.06	99.90%	< 0.75	99.93%	< 0.70	99.93%	< 0.46	99.95%	< 0.50	99.95%
N-Nitrosodiphenylamine	< 3.6	< 0.70	80.56%	< 0.33	90.83%	< 0.35	90.28%	< 0.33	90.97%	< 0.22	93.89%	< 0.24	93.47%
2-Methylnaphthalene	269	121	55.02%	5.44	97.98%	0.509	99.81%	0.424	99.84%	0.205	99.92%	< 0.44	99.84%

Compound of Concern	Raw Material	SOILTECH: 300/15 (total / % reduction)		SOILTECH: 300/25 (total / % reduction)		SOILTECH: 500/15 (total / % reduction)		SOILTECH: 500/25 (total / % reduction)		OBG TECH: 300/15 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION	
														Total	%
VOCs															
Benzene	33,000	1.77	99.99%	0.885	99.99%	0.575	99.99%	0.576	99.99%	0.449	99.99%	0.649	99.99%	0.486	0.00%
Toluene	5660	2.72	99.95%	3.88	99.93%	2.45	99.96%	3.81	99.93%	4.54	99.92%	2.502	99.95%	1.57	0.03%
Xylenes	529	0.696	99.87%	0.463	99.91%	0.294	99.94%	0.232	99.96%	13.6	97.43%	1.729	99.67%	4.18	0.79%
SVOCs															
Naphthalene	3460	35.2	98.98%	< 0.75	99.98%	< 0.75	99.98%	< 0.80	99.98%	462	86.65%	54.9	98.41%	144	4.16%
Nitrobenzene	100	< 0.75	99.25%	< 0.70	99.30%	< 0.70	99.30%	< 0.75	99.25%	8.63	91.33%	1.46	98.53%	2.52	2.53%
1,2-Dichlorobenzene	1020	< 0.75	99.93%	< 0.70	99.93%	< 0.70	99.93%	< 0.75	99.93%	97.1	90.48%	10.3	98.99%	30.5	2.99%
N-Nitrosodiphenylamine	< 3.6	< 0.36	90.14%	< 0.34	90.69%	< 0.33	90.83%	< 0.35	90.28%	< 0.38	89.44%	0.321	91.08%	0.052	1.44%
2-Methylnaphthalene	269	6.06	97.75%	< 0.60	99.78%	< 0.60	99.78%	< 0.65	99.76%	61.2	77.25%	7.61	97.17%	19.0	7.05%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 treatability studies.
3) Weston-1 data not included in average or standard deviation as temperature was less than 300 degrees F.
4) "<" Denotes one half MDL value.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results LTTT Treatability Study - 2VR-1

Compound of Concern	Raw Material	WESTON-1 (test run) (total / % reduction)		WESTON-2 (194/30) (total / % reduction)		WESTON-3 (324/30) (total / % reduction)		WESTON-4 (765/30) (total / % reduction)		SOILTECH: 600 F (total / % reduction)		SOILTECH: 800 F (total / % reduction)	
VOCs													
Benzene	61,000	0.0136	99.99%	4400	92.79%	5.36	99.99%	0.0101	99.99%	0.0686	99.99%	0.0382	99.99%
Toluene	16,200	0.0067	99.99%	3250	79.94%	5.14	99.97%	0.0065	99.99%	0.307	99.99%	0.0747	99.99%
Xylenes	3440	0.0051	99.99%	1690	50.87%	7.18	99.79%	< 0.0005	99.99%	< 0.001	99.99%	< 0.05	99.99%
SVOCs													
Naphthalene	9860	40.1	99.59%	2780	71.81%	995	89.91%	1.75	99.98%	< 0.75	99.99%	< 0.55	99.99%
Nitrobenzene	1330	< 0.75	99.94%	189	85.79%	< 0.75	99.94%	< 0.75	99.94%	< 0.70	99.95%	< 0.50	99.96%
1,2-Dichlorobenzene	2210	1.56	99.93%	651	70.54%	101	95.43%	< 0.75	99.97%	< 0.70	99.97%	< 0.50	99.98%
N-Nitrosodiphenylamine	< 5.5	< 0.35	93.73%	< 0.39	93.00%	< 0.36	93.55%	< 0.35	93.64%	< 0.34	93.82%	< 0.25	95.55%
2-Methylnaphthalene	1520	5.62	99.63%	426	71.97%	113	92.57%	< 0.13	99.99%	< 0.60	99.96%	< 0.45	99.97%

Compound of Concern	Raw Material	SOILTECH: 300/15 (total / % reduction)		SOILTECH: 300/25 (total / % reduction)		SOILTECH: 500/15 (total / % reduction)		SOILTECH: 500/25 (total / % reduction)		OBG TECH: 300/15 (total / % reduction)		AVERAGES (total /% reduction)		STANDARD DEVIATION	
														Total	%
VOCs															
Benzene	61,000	0.0157	99.99%	0.0398	99.99%	0.0132	99.99%	0.0068	99.99%	0.0734	99.99%	0.625	99.99%	1.78	0.00%
Toluene	16,200	0.0604	99.99%	0.0503	99.99%	0.0326	99.99%	0.0241	99.99%	0.792	99.99%	0.721	99.99%	1.68	0.01%
Xylenes	3440	0.0046	99.99%	0.0057	99.99%	0.0029	99.99%	< 0.0005	99.99%	6.8	99.80%	1.561	99.95%	3.08	0.09%
SVOCs					99.99%										
Naphthalene	9860	5.2	99.95%	< 0.16	99.99%	0.0675	99.99%	< 0.027	99.99%	839	91.49%	205	97.92%	406	4.11%
Nitrobenzene	1330	< 0.025	99.99%	< 0.15	99.99%	< 0.15	99.99%	< 0.025	99.99%	65	95.11%	7.56	99.43%	21.5	1.62%
1,2-Dichlorobenzene	2210	0.148	99.99%	< 0.15	99.99%	< 0.15	99.99%	< 0.025	99.99%	108	95.11%	23.5	98.94%	46.0	2.08%
N-Nitrosodiphenylamine	< 5.5	< 0.012	99.78%	< 0.07	98.73%	< 0.07	98.73%	< 0.012	99.79%	< 0.35	93.64%	0.200	96.36%	0.156	2.84%
2-Methylnaphthalene	1520	1	99.93%	< 0.13	99.99%	< 0.13	99.99%	< 0.022	99.99%	143	90.59%	28.7	98.11%	56.8	3.74%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 treatability studies.
3) Weston-1 data not included in average or standard deviation as it was a test run.
4) Weston-2 data not included in average or standard deviation as temperature was less than 300 degrees F.
5) "<" Denotes one half MDL value.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results LTTT Treatability Study - 1MIX-1

Compound of Concern	Raw Material	WESTON-1 (217/10) (total / % reduction)		WESTON-2 (463/10) (total / % reduction)		WESTON-3 (596/12) (total / % reduction)		WESTON-4 (Dup) (total / % reduction)		SOILTECH: 600 F (total / % reduction)		SOILTECH: 800 F (total / % reduction)	
VOCs													
Benzene	38,700	178	99.54%	1.79	99.99%	2.01	99.99%	25.3	99.93%	0.546	99.99%	0.524	99.99%
Toluene	101	186	-	1.35	98.66%	5.91	94.15%	128	-	2.27	97.75%	1.42	98.59%
Xylenes	1760	160	90.91%	1.16	99.93%	2.04	99.88%	36.3	97.94%	0.576	99.97%	0.235	99.99%
SVOCs													
Naphthalene	1390	2.96	99.79%	12.6	99.09%	1.09	99.92%	2.87	99.79%	0.337	99.98%	< 0.60	99.96%
Nitrobenzene	365	< 0.70	99.81%	< 0.70	99.81%	< 0.70	99.81%	< 0.70	99.81%	< 0.45	99.88%	< 0.60	99.84%
1,2-Dichlorobenzene	310	< 0.70	99.77%	< 0.70	99.77%	< 0.70	99.77%	< 0.70	99.77%	< 0.45	99.85%	< 0.60	99.81%
N-Nitrosodiphenylamine	< 0.85	< 0.34	60.59%	< 0.33	61.76%	< 0.33	61.18%	< 0.33	61.18%	< 0.21	75.29%	< 0.26	69.41%
2-Methylnaphthalene	169	1.35	99.20%	1.93	98.86%	0.535	99.68%	1.17	99.31%	0.282	99.83%	< 0.50	99.70%

Compound of Concern	Raw Material	SOILTECH: 300/15 (total / % reduction)		SOILTECH: 300/25 (total / % reduction)		SOILTECH: 500/15 (total / % reduction)		SOILTECH: 500/25 (total / % reduction)		OBG TECH: 300/15 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION Total	STANDARD DEVIATION %
VOCs															
Benzene	38,700	0.118	99.99%	2.17	99.99%	1.12	99.99%	1.04	99.99%	4.84	99.99%	3.95	99.99%	7.62	0.02%
Toluene	101	0.0408	99.96%	1.97	98.05%	3.41	96.62%	5.44	94.61%	19.3	80.89%	16.9	NC	39.4	5.79%
Xylenes	1760	0.0167	99.99%	0.322	99.98%	0.338	99.98%	0.317	99.98%	37.4	97.88%	7.87	99.55%	15.3	0.87%
SVOCs															
Naphthalene	1390	103	92.59%	4.42	99.68%	0.45	99.97%	< 0.80	99.94%	287	79.35%	41.3	97.03%	92.0	6.62%
Nitrobenzene	365	< 0.60	99.84%	< 0.70	99.81%	< 0.70	99.81%	< 0.70	99.81%	26.3	92.79%	3.22	99.12%	8.11	2.22%
1,2-Dichlorobenzene	310	6.1	98.03%	< 0.70	99.77%	< 0.70	99.77%	< 0.70	99.77%	45.2	85.42%	5.66	98.18%	14.0	4.52%
N-Nitrosodiphenylamine	< 0.85	< 0.29	66.47%	< 0.33	61.18%	< 0.34	60.59%	< 0.35	59.41%	< 0.39	54.12%	0.314	63.06%	0.050	5.90%
2-Methylnaphthalene	169	14.5	91.42%	1.25	99.26%	< 0.60	99.64%	< 0.65	99.62%	32.2	80.95%	5.36	96.83%	10.4	6.14%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 treatability studies.
3) Weston-1 data not included in average or standard deviation as temperature was less than 300 degrees F.
4) "NC" denotes value not calculated.
5) "<" Denotes one half MDL value.

AMERICAN HOME PRODUCTS CORPORATION
Treatment Objectives Analysis

Summary Results LTTT Treatability Study - 2MIX-1

Compound of Concern	Raw Material	WESTON-1 (295/17) (total / % reduction)		WESTON-2 (510/19) (total / % reduction)		WESTON-3 (533/15) (total / % reduction)		WESTON-4 (549/15) (total / % reduction)		SOILTECH: 600 F (total / % reduction)		SOILTECH: 800 F (total / % reduction)	
VOCs													
Benzene	43,400	34.5	99.92%	0.518	99.99%	0.657	99.99%	0.624	99.99%	0.4	99.99%	0.321	99.99%
Toluene	8780	52.3	99.40%	0.786	99.99%	1.44	99.98%	1.31	99.99%	1.86	99.98%	0.38	99.99%
Xylenes	874	46	94.74%	0.32	99.96%	0.458	99.95%	0.305	99.97%	0.433	99.95%	< 0.05	99.99%
SVOCs													
Naphthalene	4740	1480	68.78%	41.6	99.12%	< 0.75	99.98%	< 0.75	99.98%	0.271	99.99%	< 0.60	99.99%
Nitrobenzene	< 8.5	< 1.4	83.53%	< 0.70	91.76%	< 0.70	91.76%	< 0.70	91.76%	< 0.70	91.76%	< 0.55	93.53%
1,2-Dichlorobenzene	1000	154	84.60%	0.793	99.92%	< 0.70	99.93%	< 0.70	99.93%	< 0.70	99.93%	< 0.55	99.95%
N-Nitrosodiphenylamine	< 4.1	< 1.3	68.29%	< 0.67	83.66%	< 0.34	91.71%	< 0.33	92.07%	< 0.34	91.71%	< 0.26	93.66%
2-Methylnaphthalene	430	101	76.51%	6.02	98.60%	< 0.60	99.86%	< 0.60	99.86%	< 0.16	99.96%	< 0.47	99.89%

Compound of Concern	Raw Material	SOILTECH: 300/15 (total / % reduction)		SOILTECH: 300/25 (total / % reduction)		SOILTECH: 500/15 (total / % reduction)		SOILTECH: 500/25 (total / % reduction)		OBG TECH: 300/15 (total / % reduction)		AVERAGES (total / % reduction)		STANDARD DEVIATION Total	STANDARD DEVIATION %
VOCs															
Benzene	43,400	0.66	99.99%	0.227	99.99%	0.608	99.99%	0.17	99.99%	1.19	99.99%	3.63	99.98%	10.2	0.02%
Toluene	8780	0.665	99.99%	0.424	99.99%	1.56	99.98%	1.11	99.99%	6.38	99.93%	6.20	99.93%	15.4	0.17%
Xylenes	874	0.314	99.96%	0.0855	99.99%	0.264	99.97%	0.176	99.98%	13.9	98.41%	5.66	99.35%	14.0	1.60%
SVOCs															
Naphthalene	4740	78	98.35%	2.28	99.95%	< 0.75	99.98%	< 0.80	99.98%	666	85.95%	207	95.64%	466	9.83%
Nitrobenzene	< 8.5	< 0.65	92.35%	< 0.65	92.35%	< 0.70	91.76%	< 0.75	91.18%	24.8	-	2.94	NC	7.25	2.76%
1,2-Dichlorobenzene	1000	< 0.65	99.94%	< 0.65	99.94%	< 0.70	99.93%	< 0.75	99.93%	86.9	91.31%	22.5	97.75%	50.7	5.07%
N-Nitrosodiphenylamine	< 4.1	< 0.31	92.56%	< 0.32	92.32%	< 0.34	91.71%	< 0.35	91.46%	< 0.32	92.32%	0.442	89.22%	0.304	7.42%
2-Methylnaphthalene	430	13.5	96.86%	0.617	99.86%	< 0.60	99.86%	< 0.65	99.85%	84.5	80.35%	19.0	95.59%	36.9	8.58%

Notes:
1) Data presented in mg/kg (ppm).
2) Data from O'Brien & Gere 1995 treatability studies.
3) "NC" denotes value not calculated.
4) "<" Denotes one half MDL value.

APPENDIX F

Treatability scale-up factors

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS
June 1997

Description of Scale-up Factors

Treatment objectives must be established which are consistently attainable and demonstrated through compliance sampling once full scale treatment is implemented. To generate these treatment objectives, the pilot-scale analytical results, which represent achievable levels for the Group III impoundment materials, must be adjusted to account for scale-up to full-scale treatment. The primary components of full-scale treatment that would affect the concentrations in the final treated material are:

- removal efficiency
- ability to analytically demonstrate the consistency of that removal.

These components are, in turn, dependent upon three variables, including:

- the consistency of material,
- the ability of the analytical method to accurately depict the constituent concentrations; and,
- the representative sampling of the treated materials

Scale-up factors based on standard statistical methods and regulatory guidance were developed to address these components.

- **Consistency of material.** The variability between pilot test treatment samples can be viewed as the standard deviation of the results (concentration value).
    - Three standard deviations away from the mean value incorporates variability inherent in approximately 99% of the sample analyses (Mendenhall and Sincich).
    - If viewed relative to the mean, it is anticipated that the compliance limit would still be exceeded, statistically, by one percent of the samples. This is not acceptable in establishing compliance levels for a full-scale system.
    - Threfore, applying three standard deviations to the achievable pilot test results ("maximum of the minimum" values), shift the confidence interval to account for the values which would exceed three standard deviations from the mean
- **Analytical method variability.** Analytical and instrumental variation will also affect the reported results. Both of these factors are routinely evaluated in the laboratory through the addition of external standards or surrogates to the samples.
    - Typically, analytical responses of 10% to 30% over the actual result can be observed and are accepted by regulatory agencies. This is standard within approved analytical methodologies such as SW846 and CLP.SOW OLM01.0.
    - An adjustment of 10% will be utilized to account for analytical variability.

Description of Scale-up Factors

- **Representative sampling.** Sample collection of heterogenous materials, such as those present within the Group III Impoundments, also provides a recognized variability in meeting established limits.
    - The NJDEP has adopted the use of compliance criteria for environmental remediations requiring sampling (Site Remediation News, Spring 1995, Volume 7, Number 2). This includes the use of a "maximum allowable concentration" in determining compliance. This method prevents indicating non-compliance based on a result which may not be representative of a prevailing condition.
    - The NJDEP has accepted the use of five times the analytical result, with a ceiling of 200 ppm, as appropriate in developing compliance criteria.

Development of scale-up factors.
The treatment objectives will be developed using the following application of adjustment factors:

- Determine treatment levels for each compound of concern based on the "maximum of the minimum" treatability results.
- Add three standard deviations to each level to account for *inconsistency of material* during treatment.
- Adjust the result by 10% to account for *analytical variability.*
- Multiply the resultant by 5 and/or compare to the ceiling of 200 ppm to account for *sampling variability.*

Description of Scale-up Factors

Sample calculation for determining the bioremediation scale-up value for benzene

Step 1: Determine the maximum of the minimum concentrations for benzene. The minimum values for each impoundment (in bold) were determined from the Week 3, 6, and 9 values for the treated material.

Impoundment 4			Impoundment 5		
Wk 3	Wk 6	Wk 9	Wk 3	Wk 6	Wk 9
12	1.8	**1.2**	5.43	2.38	**1.09**

Impoundment 14			Impoundment 20			Impoundment 26		
Wk 3	Wk 6	Wk 9	Wk 3	Wk 6	Wk 9	Wk 3	Wk 6	Wk 9
1.78	2.95	1.98	3.6	1.41	**0.61**	0.0024	1.15	**0.001**

Compound	Minimum					Max of Minimum
	I-4	I-5	I-14	I-20	I-26	
Compounds of Concern						
Benzene	1.2	1.09	1.78	0.610	0.001	1.78

The maximum of the minimum for benzene: 1.78

Step 2: Determine the overall average of all of the data points (Weeks 3, 6 & 9) in all impoundments (4, 5, 14, 20 & 26).

AVG = (12 + 1.8 + 1.2 + 5.43 + 2.38 + 1.09 + 1.78 + 1.98 + 2.95 +1.98 + 3.6 + 1.41 + 0.61 + 0.0024 + 1.15 + 0.00052) / 15

AVG = 2.49

Step 3: Determine the standard deviation of the set of values used above in Step 2.

STDS = 2.98

Description of Scale-up Factors

Step 4: Determine the weighted average of the minimums:

I-4: 1.2 ppm x 0.007 (weighting factor) = 0.01
I-5: 1.09 ppm x 0.78 = 0.85
I-14: 1.78 ppm x 0.03 = 0.05
I-20: 0.61 ppm x 0.058 = 0.035
I-26: 0.001 ppm x 0.13 = 0.0001

Weighted average = 0.01 + 0.85 + 0.05 + 0.035 + 0.0001 = 0.94 ppm

Step 5: To adjust for inconsistency of material, three standard deviations were added to the maximum of the minimum treated value and the weighted average. The adjusted value for three standard deviations:

Adj. Value = Max. of Minimum + (3 x STDS)

= 1.78 + (3 x 2.98)

= 10.7

Note: The Max. of the Minimum in this case is actually lower than the average.

Adj. Value = Weighted Average + (3 x STDS) = 9.9

Step 6: To adjust for analytical variability, ten percent was added to the adjusted values calculated in step 4.

10% Lab. Variance = Adj. Value x 1.10

= 10.7 x 1.10 = 12 (for the Maximum Compliance Value)

= 9.9 x 1.10 = 10.9 (for the Average Compliance Value)

Step 7: To adjust for inconsistency of sampling from a heterogenous materials, a scale-up factor of five times the analytical results with a ceiling of 200 ppm was applied:

5X Scale-up = 10% Lab. Variance x 5

= 12 x 5 = 60 (for the Maximum Compliance Value)

= 10.9 x 5 = 54 (for the Average Compliance Value)

Step 8: Since 60 ppm and 54 ppm are below the ceiling of 200 ppm, they will be used as the Treatment Objective-Maximum and Average Compliance Values, respectively.

APPENDIX G

UTS and UTS variance comparison

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
COMPOUNDS OF CONCERN							
benzene	61,000	100	0.5 - 10	90 - 99.9	61 - 6100	85	10
toluene	16,200	100	0.5 - 10	90 - 99	162 - 1620	200	10
xylenes (total)	3,440	100	0.5 - 10	90 - 99	34 - 344	115	30
naphthalene	* 11,000	400	0.5 - 20	95 - 99	110 - 550	670	5.6
nitrobenzene	***1,330***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***165***	***14***
1,2-dichlorobenzene	* 6,100	200	0.5 - 20	90 - 99.9	6.1 - 610	200	6
N-nitrosodiphenylamine	150	100	0.5 - 10	90 - 99	2 - 15	5	13
2-methylnaphthalene	**** 1,520***	***400***	***0.5 - 20***	***95 - 99***	***15 - 76***	***200***	***7***
HALOGENATED NON-POLAR AROMATICS		***100***	***0.5 - 10***	***90 - 99.9***			
1,4-dichlorobenzene	* 1,200	100	0.5 - 10	90 - 99.9	1.20 - 120	30	6
hexachlorobenzene	< 180	100	0.5 - 10	90 - 99.9	0.18 - 18	15	10
1,2,4-trichlorobenzene	70	100	0.5 - 10	90 - 99.9	0.50 - 10	10	19
HALOGENATED PHENOLS		***400***	***0.5 - 40***	***90 - 99***			
4-chloroaniline	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	15	16
2-chlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	25	5.7
4-chloro-3-methylphenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	25	14
2,4-dichlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	30	14
pentachlorophenol	*< 890	400	0.5 - 40	90 - 99	8.90 - 89	30	7.4
2,4,5-trichlorophenol	*< 890	400	0.5 - 40	90 - 99	8.90 - 89	25	7.4
2,4,6-trichlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	20	7.4
HALOGENATED ALIPHATICS		***40***	***0.5 - 2***	***95 - 99.9***			
bromodichloromethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	15
bromoform	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	5	15
bromomethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	2	15
carbon tetrachloride	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
chloroethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1	6
chloroform	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1	6
chloromethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1	30
dibromochloromethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	15
1,1-dichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,2-dichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,1-dichloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
trans-1,2-dichloroethylene	< 280	40	0.5 - 2	95 - 99.9	0.28 - 14	1	30
1,2-dichloropropane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	18

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
cis-1,3-dichloropropene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	18
trans-1,3-dichloropropene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	18
hexachlorobutadiene	*< *180*	*40*	*0.5 - 2*	*95 - 99.9*	*0.2 - 9*	*10*	*5.6*
hexachloroethane	*< *180*	*40*	*0.5 - 2*	*95 - 99.9*	*0.2 - 9*	*20*	*30*
methylene chloride	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	30
1,1,2,2-tetrachloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	5	6
tetrachloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,1,1-trichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,1,2-trichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
trichloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
vinyl chloride	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	2	6
HALOGENATED CYCLICS		*200*	*0.5 - 20*	*90 - 99.9*			
chlorobenzene	*< 1,100	200	0.5 - 20	90 - 99.9	1.1 - 110	1	6
2-chloronaphthalene	*378*	*200*	*0.5 - 20*	*90 - 99.9*	*0.4 - 37.8*	*50*	*5.6*
1,3-dichlorobenzene	* 190	200	0.5 - 20	90 - 99.9	0.50 - 20	10	6
hexachlorocyclopentadiene	< 180	200	0.5 - 20	90 - 99.9	0.50 - 20	20	2.4
NITRATED AROMATICS		*10,000*	*2.5 - 10*	*99.9 - 99.99*			
4,6-dinitro-o-cresol	*< *890*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*30*	*160*
2,4-dinitrotoluene	*< *63*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*20*	*140*
2,6-dinitrotoluene	*< *180*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*15*	*28*
2-nitroaniline	*< *890*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*15*	*14*
3-nitroaniline	*< *890*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*15*	*14*
4-nitroaniline	*< *890*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*10*	*28*
2-nitrophenol	*< *180*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*35*	*13*
4-nitrophenol	*< *890*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*50*	*29*
POLYNUCLEAR AROMATICS		*400*	*0.5 - 20*	*95 - 99*			
acenaphthene	*< *180*	*400*	*0.5 - 20*	*95 - 99*	*0.5 - 20*	*90*	*3.4*
anthracene	*< *180*	*400*	*0.5 - 20*	*95 - 99*	*0.5 - 20*	*55*	*3.4*
benzo(a)anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	3.4
benzo(a)pyrene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	3.4
benzo(b)fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	6.8
benzo(g,h,i)perylene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5	1.8
benzo(k)fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	20	6.8
chrysene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5	3.4
dibenzo(a,h)anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	8.2

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	15	3.4
fluorene	** 2,800*	*400*	*0.5 - 20*	*95 - 99*	*28.0 - 140*	*200*	*3.4*
indeno(1,2,3-cd)pyrene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5	3.4
phenathrene	** 360*	*400*	*0.5 - 20*	*95 - 99*	*0.5 - 20*	*50*	*5.6*
pyrene	* 40	400	0.5 - 20	95 - 99	1 - 20	10	8.2
OTHER POLAR ORGANICS		*100*	*0.5 - 10*	*90 - 99*			
acetone	< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	15	160
benzoic acid	884	100	0.5 - 10	90 - 99	8.8 - 88.4	80	8
bis(2-chloroethoxy) methane	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	15	7.2
bis(2-chloroethyl)ether	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	6
bis(2-ethylhexyl)phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	28
4-bromophenyl·phenyl ether	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	15
2-butanone	*< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	3	36
butyl benzyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	28
carbon disulfide	*< 1,100	100	0.5 - 10	90 - 99	11.00 - 110	2	4.8
diethylphthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	28
2,4-dimethylphenol	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	14
dimethylphthalate	*< 180	100	0.5 - 10	90 - 99	2 - 18	10	28
di-n-butyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	28
2,4-dinitrophenol	*< 890	100	0.5 - 10	90 - 99	8.90 - 89	65	160
di-n-octyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	28
ethylbenzene	**< 1,100*	*100*	*0.5 - 10*	*90 - 99*	*11.0 - 110*	*200*	*10*
2-hexanone	*< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	1	33
phenol	240	100	0.5 - 10	90 - 99	2.4 - 24	20	6.2

Notes: Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Low Temperature Thermal Treatment field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used. Results indicated with "*" are drawn from the Impoundment 3 Bioremediation field pilot study.

(2) If compound analytical result is less than threshold value, then concentration range is shown.

(3) Other technologies may be used if treatability studies or other information indicates that they can achieve the necessary concentration of percent-reduction range.

(4) TCLP also may be used when evaluating material with relatively low levels of organics that have been treated through an immobilization process.

(5) Shown as the concentration range if the analtyical result is less than the threshold value, and as the percent reduction of the feed data if the analytical result is greater than the threshold value.

(6) Maximum treatment objectives calculated in accordance with Section 5.6 and Appendix F.

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
COMPOUNDS OF CONCERN							
benzene	21,000	100	0.5 - 10	90 - 99.9	21 - 2100	60	10
toluene	3,100	100	0.5 - 10	90 - 99	31 - 310	145	10
xylenes (total)	5,500	100	0.5 - 10	90 - 99	55 - 550	230	30
naphthalene	***240,000***	***400***	***0.5 - 20***	***95 - 99***	***2400 - 12000***	***13,100***	***6***
nitrobenzene	***< 8,500***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***5200***	***14***
1,2-dichlorobenzene	1,500	200	0.5 - 20	90 - 99.9	1.5 - 150	320	6
N-nitrosodiphenylamine	***21,000***	***100***	***0.5 - 10***	***90 - 99***	***210 - 2100***	***14,300***	***13***
2-methylnaphthalene	***9,200***	***400***	***0.5 - 20***	***95 - 99***	***92.0 - 460***	***1900***	***7***
HALOGENATED NON-POLAR AROMATICS		***100***	***0.5 - 10***	***90 - 99.9***			
1,4-dichlorobenzene	***< 960***	***100***	***0.5 - 10***	***90 - 99.9***	***0.96 - 96***	***170***	***6***
hexachlorobenzene	< 1,200	100	0.5 - 10	90 - 99.9	1.20 - 120	100	10
1,2,4-trichlorobenzene	***2,700***	***100***	***0.5 - 10***	***90 - 99.9***	***2.70 - 270***	***1300***	***19***
HALOGENATED PHENOLS		***400***	***0.5 - 40***	***90 - 99***			
4-chloroaniline	< 1,200	400	0.5 - 40	90 - 99	12.0 - 120	115	16
2-chlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***5.7***
4-chloro-3-methylphenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***14***
2,4-dichlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***14***
pentachlorophenol	< 6,100	400	0.5 - 40	90 - 99	61.00 - 610	200	7.4
2,4,5-trichlorophenol	< 6,100	400	0.5 - 40	90 - 99	61.00 - 610	200	7.4
2,4,6-trichlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***7.4***
HALOGENATED ALIPHATICS		***40***	***0.5 - 2***	***95 - 99.9***			
bromodichloromethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	15
bromoform	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	3	15
bromomethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	15
carbon tetrachloride	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
chloroethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	6
chloroform	800	40	0.5 - 2	95 - 99.9	0.80 - 40	15	6
chloromethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	30
dibromochloromethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	1	15
1,1-dichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,2-dichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,1-dichloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
trans-1,2-dichloroethylene	-	40	0.5 - 2	95 - 99.9	0.50 - 2	5	30
1,2-dichloropropane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	18

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
cis-1,3-dichloropropene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	18
trans-1,3-dichloropropene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	3	18
hexachlorobutadiene	*< 1,200*	*40*	*0.5 - 2*	*95 - 99.9*	*1.20 - 60*	*100*	*5.6*
hexachloroethane	*< 1,200*	*40*	*0.5 - 2*	*95 - 99.9*	*1.20 - 60*	*165*	*30*
methylene chloride	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	30
1,1,2,2-tetrachloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	2	6
tetrachloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	25	6
1,1,1-trichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,1,2-trichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
trichloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
vinyl chloride	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	10	6
HALOGENATED CYCLICS		*200*	*0.5 - 20*	*90 - 99.9*			
chlorobenzene	4,100	200	0.5 - 20	90 - 99.9	4.1 - 410	200	6
2-chloronaphthalene	*< 1,200*	*200*	*0.5 - 20*	*90 - 99.9*	*1.20 - 120*	*200*	*5.6*
1,3-dichlorobenzene	< 1,200	200	0.5 - 20	90 - 99.9	1.20 - 120	70	6
hexachlorocyclopentadiene	*< 1,200*	*200*	*0.5 - 20*	*90 - 99.9*	*1.20 - 120*	*185*	*2.4*
NITRATED AROMATICS		*10,000*	*2.5 - 10*	*99.9 - 99.99*			
4,6-dinitro-o-cresol	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*160*
2,4-dinitrotoluene	*< 1,200*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*140*
2,6-dinitrotoluene	*< 1,200*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*125*	*28*
2-nitroaniline	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*125*	*14*
3-nitroaniline	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*135*	*14*
4-nitroaniline	*< 4,800*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*85*	*28*
2-nitrophenol	*< 1,200*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*13*
4-nitrophenol	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*29*
POLYNUCLEAR AROMATICS		*400*	*0.5 - 20*	*95 - 99*			
acenaphthene	*1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*380*	*3.4*
anthracene	*560*	*400*	*0.5 - 20*	*95 - 99*	*5.6 - 28*	*210*	*3.4*
benzo(a)anthracene	*490*	*400*	*0.5 - 20*	*95 - 99*	*4.9 - 24.5*	*1000*	*3.4*
benzo(a)pyrene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*75*	*3.4*
benzo(b)fluoranthene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*65*	*6.8*
benzo(g,h,i)perylene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	60	1.8
benzo(k)fluoranthene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*125*	*6.8*
chrysene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*75*	*3.4*
dibenzo(a,h)anthracene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*85*	*8.2*

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
fluoranthene	***< 960***	***400***	***0.5 - 20***	***95 - 99***	***9.6 - 48***	***200***	***3.4***
fluorene	***3,200***	***400***	***0.5 - 20***	***95 - 99***	***32.0 - 160***	***650***	***3.4***
indeno(1,2,3-cd)pyrene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	40	3.4
phenathrene	***1,300***	***400***	***0.5 - 20***	***95 - 99***	***13 - 65***	***390***	***5.6***
pyrene	***< 960***	***400***	***0.5 - 20***	***95 - 99***	***10 - 48***	***200***	***8.2***
OTHER POLAR ORGANICS		***100***	***0.5 - 10***	***90 - 99***			
acetone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	160
benzoic acid	-	***100***	***0.5 - 10***	***90 - 99***	***0.5 - 10***	***200***	***8***
bis(2-chloroethoxy) methane	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***125***	***7.2***
bis(2-chloroethyl)ether	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	85	6
bis(2-ethylhexyl)phthalate	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***28***
4-bromophenyl phenyl ether	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	75	15
2-butanone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	36
butyl benzyl phthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	30	28
carbon disulfide	< 790	100	0.5 - 10	90 - 99	7.90 - 79	5	4.8
diethylphthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	75	28
2,4-dimethylphenol	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***14***
dimethylphthalate	3,400	100	0.5 - 10	90 - 99	34 - 340	75	28
di-n-butyl phthalate	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***28***
2,4-dinitrophenol	< 6,100	100	0.5 - 10	90 - 99	61.00 - 610	200	160
di-n-octyl phthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	65	28
ethylbenzene	***1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***165***	***10***
2-hexanone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	33
phenol	***< 960***	***100***	***0.5 - 10***	***90 - 99***	***9.6 - 96***	***200***	***6.2***

Notes: **Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.**

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Bioremediation field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used.

(2) If compound analytical result is less than threshold value, then concentration range is shown.

(3) Other technologies may be used if treatability studies or other information indicates that they can achieve the necessary concentration of percent-reduction range.

(4) TCLP also may be used when evaluating material with relatively low levels of organics that have been treated through an immobilization process.

(5) Shown as the concentration range if the analytical result is less than the threshold value, and as the percent reduction of the feed data if the analytical result is greater than the threshold value

(6) Maximum treatment objectives calculated in accordance with Section 5.6 and Appendix F.

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Average Treatment Level	Average (2,3) Percent Reduction
NON-POLAR AROMATICS				
Total:	**21,000**	**90 - 100**	**54**	**99.7%**
benzene	*21,000*	*90 - 99.9*	*54*	*99.7%*
HALOGENATED NON-POLAR AROMATICS				
Total:	**4,860**	**90 - 99.9**	**1570**	**67.7%**
1,4-dichlorobenzene	< 960	90 - 99.9	170	82.3%
hexachlorobenzene	< 1,200	90 - 99.9	100	91.7%
1,2,4-trichlorobenzene	2,700	90 - 99.9	1300	51.9%
HALOGENATED PHENOLS				
Total:	**18,200**	**90 - 99**	**1315**	**92.8%**
4-chloroaniline	< 1,200	90 - 99	115	90.4%
2-chlorophenol	< 1,200	90 - 99	200	83.3%
4-chloro-3-methylphenol	< 1,200	90 - 99	200	83.3%
2,4-dichlorophenol	< 1,200	90 - 99	200	83.3%
pentachlorophenol	< 6,100	90 - 99	200	96.7%
2,4,5-trichlorophenol	< 6,100	90 - 99	200	96.7%
2,4,6-trichlorophenol	< 1,200	90 - 99	200	83.3%
HALOGENATED ALIPHATICS				
Total:	**21,840**	**95 - 99.9**	**394**	**98.2%**
bromodichloromethane	< 790	95 - 99.9	5	99.4%
bromoform	< 790	95 - 99.9	3	99.6%
bromomethane	< 1,500	95 - 99.9	5	99.7%
carbon tetrachloride	< 790	95 - 99.9	5	99.4%
chloroethane	< 1,500	95 - 99.9	5	99.7%
chloroform	800	95 - 99.9	15	98.1%
chloromethane	< 1,500	95 - 99.9	5	99.7%
dibromochloromethane	< 790	95 - 99.9	1	99.9%
1,1-dichloroethane	< 790	95 - 99.9	5	99.4%
1,2-dichloroethane	< 790	95 - 99.9	5	99.4%
1,1-dichloroethylene	< 790	95 - 99.9	5	99.4%
1,2-dichloropropane	< 790	95 - 99.9	5	99.4%
cis-1,3-dichloropropene	< 790	95 - 99.9	5	99.4%
trans-1,3-dichloropropene	< 790	95 - 99.9	3	99.6%
hexachlorobutadiene	< 1,200	95 - 99.9	100	91.7%
hexachloroethane	< 1,200	95 - 99.9	165	86.3%
methylene chloride	< 790	95 - 99.9	5	99.4%
1,1,2,2-tetrachloroethane	< 790	95 - 99.9	2	99.7%
tetrachloroethylene	< 790	95 - 99.9	25	96.8%
1,1,1-trichloroethane	< 790	95 - 99.9	5	99.4%
1,1,2-trichloroethane	< 790	95 - 99.9	5	99.4%
trichloroethylene	< 790	95 - 99.9	5	99.4%
vinyl chloride	< 1,500	95 - 99.9	10	99.3%

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Average Treatment Level	Average (2,3) Percent Reduction
HALOGENATED CYCLICS				
Total:	**9,200**	**90 - 99.9**	**905**	**90.2%**
1,2-dichlorobenzene	*1,500*	*90 - 99.9*	*250*	*83.3%*
chlorobenzene	4,100	90 - 99.9	200	95.1%
2-chloronaphthalene	< 1,200	90 - 99.9	200	83.3%
1,3-dichlorobenzene	< 1,200	90 - 99.9	70	94.2%
hexachlorocyclopentadiene	< 1,200	90 - 99.9	185	84.6%
NITRATED AROMATICS				
Total:	**41,300**	**99.9 - 99.99**	**4630**	**88.8%**
nitrobenzene	*8,500*	*99.9 - 99.99*	*3360*	*60.5%*
4,6-dinitro-o-cresol	< 6,100	99.9 - 99.99	200	96.7%
2,4-dinitrotoluene	< 1,200	99.9 - 99.99	200	83.3%
2,6-dinitrotoluene	< 1,200	99.9 - 99.99	125	89.6%
2-nitroaniline	< 6,100	99.9 - 99.99	125	98.0%
3-nitroaniline	< 6,100	99.9 - 99.99	135	97.8%
4-nitroaniline	< 4,800	99.9 - 99.99	85	98.2%
2-nitrophenol	< 1,200	99.9 - 99.99	200	83.3%
4-nitrophenol	< 6,100	99.9 - 99.99	200	96.7%
POLYNUCLEAR AROMATICS				
Total:	**266,270**	**95 - 99**	**17,315**	**93.5%**
naphthalene	*240,000*	*95 - 99*	*12,000*	*95.0%*
2-methylnaphthalene	*9,200*	*95 - 99*	*1760*	*80.9%*
acenaphthene	1,200	95 - 99	380	68.3%
anthracene	560	95 - 99	210	62.5%
benzo(a)anthracene	490	95 - 99	1000	N/A
benzo(a)pyrene	< 1,200	95 - 99	75	93.8%
benzo(b)fluoranthene	< 1,200	95 - 99	65	94.6%
benzo(g,h,i)perylene	< 1,200	95 - 99	60	95.0%
benzo(k)fluoranthene	< 1,200	95 - 99	125	89.6%
chrysene	< 1,200	95 - 99	75	93.8%
dibenzo(a,h)anthracene	< 1,200	95 - 99	85	92.9%
fluoranthene	< 960	95 - 99	200	79.2%
fluorene	3,200	95 - 99	650	79.7%
indeno(1,2,3-cd)pyrene	< 1,200	95 - 99	40	96.7%
phenathrene	1,300	95 - 99	390	70.0%
pyrene	< 960	95 - 99	200	79.2%

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Average Treatment Level	Average (2,3) Percent Reduction
OTHER POLAR ORGANICS				
Total:	**57,350**	**90 - 99**	**14040**	**75.5%**
toluene	*3,100*	*90 - 99*	*145*	*95.3%*
xylenes (total)	*5,500*	*90 - 99*	*180*	*96.7%*
N-nitrosodiphenylamine	*21,000*	*90 - 99*	*12,000*	*42.9%*
acetone	< 1,500	90 - 99	5	99.7%
bis(2-chloroethoxy) methane	< 1,200	90 - 99	125	89.6%
bis(2-chloroethyl)ether	< 1,200	90 - 99	85	92.9%
bis(2-ethylhexyl)phthalate	< 1,200	90 - 99	200	83.3%
4-bromophenyl phenyl ether	< 1,200	90 - 99	75	93.8%
2-butanone	< 1,500	90 - 99	5	99.7%
butyl benzyl phthalate	< 1,200	90 - 99	30	97.5%
carbon disulfide	< 790	90 - 99	5	99.4%
diethylphthalate	< 1,200	90 - 99	75	93.8%
2,4-dimethylphenol	< 1,200	90 - 99	200	83.3%
dimethylphthalate	3,400	90 - 99	75	97.8%
di-n-butyl phthalate	< 1,200	90 - 99	200	83.3%
2,4-dinitrophenol	< 6,100	90 - 99	200	96.7%
di-n-octyl phthalate	< 1,200	90 - 99	65	94.6%
ethylbenzene	1,200	90 - 99	165	86.3%
2-hexanone	< 1,500	90 - 99	5	99.7%
phenol	< 960	90 - 99	200	79.2%

Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.

Notes:

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Bioremediation field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used.

(2) Based on 6 month average concentration.

(3) The treatement levies for the regulated compounds were only developed for use in the Alternative Treatability Evaluation. Only the eight compoun of concern (italized) are proposed for compliance monitoring.

N/A Not Applicable

APPENDIX H

Mass evaluations

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Mass Evaluation

1. **Overall mass evaluation**. The Group III impoundment waste materials subject to biotreatment include Impoundments 4, 5, 14, 20 and 26, and comprise a total mass of 230,467,800 lbs. Of this mass, 45,189,391 lbs (19.6%) consist of regulated compounds[(1)] based on sampling and analytical data. The composition of the remaining material is water, debris and non-regulated organic and inorganic compounds. The recommended treatment technology, biotreatment, will reduce the mass of regulated compounds to 3,245,266 lbs, or 1.4% of the original total mass. This corresponds to an overall reduction efficiency of 93%. The following table summarizes this evaluation:

Impoundment	Total Mass (lbs)	Mass of Regulated Compounds (lbs)	Total Mass of Regulated Compounds after Biotreatment (lbs)
4	1,963,800	60,586	4,351
5	163,650,000	44,193,028	3,173,712
14	8,728,000	645,217	46,336
20	16,528,000	263,689	18,937
26	39,600,000	26,871	1,930
Total	230,467,800	45,189,391	3,245,266
Percent		19.6%	1.4%

2. **Evaluation of Treatment Objectives.** The following table presents an evaluation, on an individual basis, for the eight compounds of concern for which treatment objectives were previously established. These compounds were identified for compliance monitoring in the April 1996 CMS/FS as they comprise greater than 96% of the total mass of regulated compounds within the Group III impoundments. The remaining regulated compounds each comprise less than 0.5% of the total mass. This evaluation considers mass and volume reduction of the contaminants based on the total mass of the waste material being considered for biotreatment (Impoundments 4, 5, 14, 20 and 26). A sample calculation regarding the mass and volume evaluation for benzene is provided attached.

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[1] "Regulated compounds" refers to the organic compounds listed in USEPA's Target Compound List. "Non-regulated compounds" refers to the remaining mass of the material not attributable to water and debris, based on mass calculations. A specific listing of non-regualted compounds does not exist.

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Mass Evaluation

Compound of Concern	Total Mass Before Biotreatment (lbs)	Percent of Waste Material	Total Mass After Biotreatment (lbs)	Percent of Waste Material	Average(1) Treatment Objective (mg/kg)
Benzene	257,901	0.11%	663	<0.01%	54
Toluene	505,878	0.22%	23,662	0.01%	145
Xylene (Total)	460,571	0.20%	15,073	<0.01%	180
Naphthalene	39,516,516	17.15%	1,975,826	0.94%	12,000
Nitrobenzene	336,361	0.14%	132,961	0.09%	3,360
1,2 Dichlorobenzene	253,235	0.11%	42,206	0.02%	250
N-Nitrosodiphenylamine	691,676	0.30%	395,243	0.20%	12,000
2-Methylnapthalene	1,526,957	0.66%	292,113	0.14%	1,760
Totals	43,549,095	18.9%	2,877,747	1.3%	

(1) Based on 6 month average concentration.

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Sample Calculation for Determining Compound Mass

Step 1: Record the compound concentration of the untreated impoundment material from each impoundment subject to biotreatment. Analytical data from the 1995 pilot programs was used.

Step 2: Calculate the impoundment volumes based on previous Impoundment Characterization Program evaluations

Step 3: Record the impoundment material density based on previous Impoundment Characterization Program evaluations.

Step 4: Calculate the total mass of waste material by multiplying the impoundment volumes by the impoundment densities and summing.

Step 5: Calculate the compound mass in each impoundment by multiplying the concentration by the volume and density, making unit conversions as necessary.

Step 6: Sum the compound masses for all of the impoundments subject to biotreatment.

Step 7: Calculate the compound weight percent in the total material by dividing the compound mass by the total mass.

Impoundment	Benzene (mg/Kg)	Impoundment Volume (cy)	Impoundment Density (lb/cy)	Total Mass (lb)	Benzene Mass (lbs)
4	21,000	900	2,182	1,963,800	41,240
5	780	75,000	2,182	163,650,000	127,647
14	350	4,000	2,182	8,728,000	3,055
20	5,200	7,800	2,119	16,528,200	85,947
26	<1	17,600	2,250	39,600,000	32
Total		105,300	2,189 (Wtd Avg)	230,470,000	257,901
				Benzene weight % in total material:	0.11%

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Sample Calculation for Determining Mass of Regulated Compounds

Step 1: Obtain mass of impoundment by multiplying volume of impoundment by density, based on values provided in Appendix C.

Step 2: Obtain mass of regulated compounds for each impoundment from pilot study data provided in Appendix C.

Step 3: Obtain the overall mass of regulated compounds after biotreatment by applying the percent reductions calculated in Appendix G for each regulated compound. This is calculated by taking the weighted concentration of each regulated compound and the regulated density for the impoundments containing that compound. Thus, an overall removal efficiency can be obtained on a compound specific basis. An example calculation for benzene is as follows:

Wtd Conc (ppm)	Total Volume (yd^3)	Wtd Density (lb/yd^3)	Compound Mass (lb)	% Red.	Mass Left (lb)
1,134	105,300	2,189	257,901	99.7	663

The overall regulated compound removal efficiency for the materials subject to biotreatment is 93%, based on this method. See attached table.

Step 4: Calculate the mass of regulated compounds after biotreatment by assigning the average 93% removal factor to each impoundment subject to biotreatment.

AMERICAN HOME PRODUCTS CORPORATION
BOUND BROOK, NEW JERSEY
Group III Impoundments (4, 5, 14, 20, 26)
Mass Reduction through Biotreatment

Compound of Concern (COC)	Wtd Conc (ppm) (1)	Total Volume (yd3) (2)	Wtd Density (lb/yd3)	Cmpd Mass (lb)	% Red (3)	Mass Remaining	% of Cmpd Remaining
Naphthalene	171,987	105,300	2,189	39,516,516	95.0%	1,975,826	4.372%
2-Methylnaphthalene	7,177	97,500	2,194	1,526,957	80.9%	292,113	0.646%
N-Nitrosodiphenylamine	3,036	104,400	2,189	691,676	42.9%	395,243	0.875%
Toluene	2,202	105,300	2,189	505,878	95.3%	23,662	0.052%
Xylenes (Total)	2,016	105,300	2,189	460,571	96.7%	15,073	0.033%
Nitrobenzene	1,596	96,600	2,194	336,361	60.5%	132,961	0.294%
Benzene	1,134	105,300	2,189	257,901	99.7%	663	0.001%
1,2-Dichlorobenzene	1,102	105,300	2,189	253,235	83.3%	42,206	0.093%
Dibenzofuran	1,353	79,900	2,182	235,959	93.5%	15,337	0.034%
Acenaphthene	1,123	93,500	2,195	229,207	68.3%	72,582	0.161%
Phenanthrene	1,015	97,500	2,194	215,902	70.0%	64,771	0.143%
Fluorene	858	79,900	2,182	149,652	79.7%	30,398	0.067%
Chloroform	800	75,000	2,182	130,920	98.1%	2,455	0.005%
Carbazole	616	79,000	2,182	106,154	93.5%	6,900	0.015%
Chlorobenzene	460	104,400	2,189	102,707	95.1%	5,010	0.011%
Anthracene	531	79,900	2,182	92,610	62.5%	34,729	0.077%
Benzo(a)anthracene	376	97,500	2,194	80,677	N/A	80,677	0.179%
Phenol	287	83,700	2,176	52,479	79.2%	10,933	0.024%
Ethylbenzene	209	105,300	2,189	47,423	86.3%	6,521	0.014%
Fluoranthene	209	93,500	2,195	42,638	79.2%	8,883	0.020%
1,4-Dichlorobenzene	153	101,300	2,189	33,749	82.3%	5,976	0.013%
Dimethylphthalate	651	21,600	2,237	30,675	97.8%	677	0.001%
Pyrene	146	92,600	2,195	29,560	79.2%	6,158	0.014%
1,2,4-Trichlorobenzene	571	22,500	2,235	28,027	51.9%	13,494	0.030%
4-Nitroaniline	140	75,000	2,182	22,911	98.2%	406	0.001%
2-Chloronaphthalene	116	21,600	2,237	5,482	83.3%	914	0.002%
4-Methylphenol	220	4,000	2,182	1,920	75.5%	470	0.001%
2,4-Dimethylphenol	110	4,000	2,182	960	83.3%	160	0.000%
4-Chloroaniline	23	7,800	2,119	380	90.4%	36	0.000%
Bis(2-ethylhexyl)phthalate	3	17,600	2,250	131	83.3%	22	0.000%
1,3-Dichlorobenzene	42	900	2,182	82	94.2%	5	0.000%
3-Nitroaniline	4	7,800	2,119	63	97.8%	1	0.000%
Acenaphthylene	13	900	2,182	26	93.5%	2	0.000%
Chrysene	1	900	2,182	2	93.8%	0	0.000%
Di-n-butylphthalate	1	900	2,182	1	83.3%	0	0.000%
Total Mass of All Material			230,470,000				
Total Mass of COCs			45,189,391			3,245,266	7.181%
				Overall COC Mass Reduction			**92.819%**

AMERICAN HOME PRODUCTS CORPORATION
BOUND BROOK, NEW JERSEY
Group III Impoundments (4, 5, 14, 20, 26)
Mass Reduction through Biotreatment

Notes:

1. Weighted Concentration for Each COC derived from Group III CMS/FS Appendices C & D as follows (using benzene as example):

Impoundment	Benzene Conc. (ppm) from 1995 pilot study	Imp. Volume (yd3)	Density (lb/yd3)	Imp. Mat'l Mass (lb)	Benzene Mass (lb)
4	21000	900	2182	1963800	41240
5	780	75000	2182	163650000	127647
14	350	4000	2182	8728000	3055
20	5200	7800	2119	16528200	85947
26	0.32	17600	2250	39600000	13
		105300		230470000	257901

Average density (lb/yd3) 230470000 / 105300 = 2189

Wtd. avg. benzene conc. (ppm) $\frac{(21000*900 + 780*75000 + 350*4000 + 5200*7800 + 0.32*17600)* 2189}{230470000}$ = 1134

2. Total volume based on sum of impoundment volumes where COC was detected (see Appendix C from Group III CMS/FS)

3. Percent reduction based on Group III CMS/FS Appendix G - Alternative Variance Treatability Levels table.

Exhibit A

Comment letter on May 1995 Group III CMS/FS Report

cc: ACJ
SJR
STF
AJC
644
PLS
FILE: 5772.004 F

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

REC'D FROM TMD
9-14-95

SEP 11 1995

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
NO. P249 580 451

Patricia Wells McDonald, Manager-Environmental Affairs
American Home Products Corporation
Department of Environment & Safety
Five Giralda Farms
Madison, NJ 07940

Dear Ms. McDonald:

Re: American Home Products Corporation/American Cyanamid Company Site
Bridgewater Township, Somerset County, New Jersey

The New Jersey Department of Environmental Protection (NJDEP) has reviewed the Group III Impoundments (3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS) Report dated May 1995 (received on May 31, 1995), prepared by Blasland, Bouck & Lee. A copy of the CMS/FS report was also forwarded to the United States Environmental Protection Agency (USEPA).

Based on the existing information submitted in the CMS/FS for the Group III Impoundments and CMS/FS for Impoundments 1 and 2 (part of Group II Impoundments), it could not be determined whether remedial alternatives evaluated would meet the Land Disposal Restrictions (LDRs) requirements. Therefore, Impoundments 1 and 2 have been moved into the Group III Impoundments. The old May 1995 Group III CMS/FS have been voided and supplemental treatability studies for thermal desorption and biotreatment have been proposed to determine achievement of LDRs. The CMS/FS report for the new Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) incorporating the results of the supplemental treatability studies is due from American Home Products on or before April 30, 1996.

Although the May 1995 Group III Impoundments CMS/FS report has been voided, the NJDEP is providing the following comments on the report, as requested by American Home Products, so that they can be incorporated into the New Group III Impoundments CMS/FS report due on or before April 30, 1996. Since the CMS/FS report has been voided, the NJDEP informed USEPA not to further review the report. As such, there are no comments from the USEPA.

1. General: All treatment remedial alternatives considered in the CMS/FS assume TCLP levels as treatment standards. As discussed above, either LDR UTS or Alternate Treatment Levels specified in Superfund Guidance 6A must be used.

2. Section 2.4.2.3, Page 2-18: Add a statement here that based on the overburden ground water monitoring data, the water which flows to the Raritan River does not have contamination above the regulatory standards.

3. Section 2.4.2.4, Page 2-19, Paragraph 2: Classification of Cuckolds Brook is provided based on the August 1989 NJDEP Surface Water Quality Standards (SWQS). The classification system from the NJDEP April 1994 SWQS, NJAC 7:9B should be used.

4. Section 2.6, Page 2-20, Last Paragraph: Explain here that remedial actions are necessary for the Group III Impoundments because they are a continuous source of ground water contamination. The ground water in the vicinity of the site is classified as a source of drinking water, although it is not used as drinking water. Although there is a pumping program to control the migration of contaminated ground water by recovering 650,000 gallons of contaminated ground water per day, the population around the site could be potentially exposed to contaminated ground water under a future use scenario. For these reasons, remediation of the Group III Impoundments is warranted.

5. Section 3.2, Page 3-4, Item "b": The correct citation for the SWQS is NJAC 7:9B.

6. Section 3.2, Page 3-4, Item "d": Should be revised to read: Prevent or eliminate continued release of contaminants into ground water that could potentially impact human health and the environment.

7. Section 3.4.2.1, Page 3-8, Paragraph 1: Should be revised to read: In summary, bioremediation involves the enhancement of natural processes able to CONVERT a broad range of VOCs and SVOCs INTO NON-TOXIC COMPOUNDS, such as those found in the Group III Impoundments.

8. Section 3.4.4.1, Page 3-16, Paragraph 1: Were the samples collected from the various impoundments composited to create "whole mass"? If so, provide details here.

9. Section 3.4.4.2, Page 3-19, Paragraph 1: Figure 3.4.5 does not provide percent of removal which should be included.

10. Section 3.4.4.3, Page 3-25, Paragraph 2: Provide details about capture and subsequent treatment/disposal for significant volatilization of benzene and chlorobenzene occurred during pre-treatment.

11. Section 3.4.3.3, Page 3-26, Impoundments 3, 4, 5 and 20: Percent reduction requirements for nitrobenzene, naphthalene, benzene and chlorobenzene as well as TCLP limit for naphthalene have not been satisfied based on the results provided in Table 3.4.5.

12. Section 3.4.4.4, Page 3-32: table 3.4.7 is referenced for TCLP results. Include percent reduction results in this table as well.

13. Section 3.4.6, Page 3-42, Paragraph 2: It is stated that Thermal Desorption (TD) and Bioremediation satisfy TCLP requirements. This is incorrect. TD and Bioremediation do not satisfy TCLP for all contaminants.

14. Section 4.1, Page 4-1, Paragraph 2: It is stated that the retained technology options are first screened based on cost estimates. In accordance with the National Contingency Plan (NCP), Section 300.430(e)(7), Page 8849, Federal Register, March 8, 1990, the technology options must first be screened against effectiveness and implementability criteria and then cost criteria.

15. Section 4.3.2, Page 4-6, Item 4: NJDEP Soil Cleanup Criteria (SCC) are no longer proposed. They are being used as guidelines.

16. Section 4.3.2.2, Page 4-8: Delete the entire discussion about the Draft Natural Resource Assessment (NRA). Only evaluate alternate-specific location specific Applicable or Relevant and Appropriate Requirements (ARARs).

17. Section 4.3.2.3, Page 4-13, Items 5 and 6: Since this is a state lead site, actual permits are required instead of complying with substantive requirements as stated.

18. Section 4.3..2.3, Page 4-13, Item 7: Approval from the appropriate Soil Conservation District is required.

19. Section 4.3.2.4, Page 4-14, Item 2: It is stated that a Corrective Action Management Unit (CAMU) may be designated by the USEPA under the RCRA Subpart S rule. This is incorrect. The CAMU may be designated under the RCRA Subtitle C program.

20. Section 4.3.3.1, Page 4-17, Paragraph 1: It is stated that the dry portion of Impoundment 5 may be a candidate for non-treatment remedial alternatives. In light of LDRs or Alternate Treatment Levels of Superfund 6A, this determination may not be valid. Impoundment 26 must also be re-evaluated in light of these requirements.

21. Section 4.3.3.3, It is stated several times in this section that solidification/stabilization has the potential to meet leachate quality objectives for Impoundments 4, 14 and 20. It is also stated in this same section that solidification tests performed for these impoundments did not satisfy the leachate quality objectives. Please explain.

22. Section 4.3.4, Page 4-24, Paragraph 1: It is stated that TCLP is a commonly used measure of treatment effectiveness. This is incorrect. TCLP is used to determine the hazardous characteristics of waste material.

23. Section 4.3.4.4, Page 4-37, Paragraph 2: It is stated that Solid Phase Bioremediation is selected over Slurry Phase Biormediation because it could meet the same ARARs and be equally effective. Based on the treatability study results provided in Tables 3.4.1 and 3.4.5, this statement is incorrect. Solid Phase Bioremediation do not meet the same ARARs and be equally effective as Slurry Phase Bioremediation.

24. Section 4.3.4.4, page 4-39, Item 10: Off-site landfill disposal would require treatment to LDR UTSs, not just satisfying TCLP levels, for Impoundments 5 (dry) and 26.

25. Section 4.3.4.5, Page 4-39, Last Paragraph: Describe the specifics and criteria for the proposed cleaning process.

26. Section 4.3.4.5, Pages 4-40 and 4-41: Monitor wells included in the on-going ground water monitoring program required under the Administrative Consent Order (ACO) may be used to determine the effectiveness of the remedial action. If impoundment-specific wells are not included or are not available, they may be included in the current monitoring program with a contingent schedule. This would avoid potential redundancy in the overall ground water monitoring program.

27. Section 4.3.4.6, Page 4-41, Item 2: Size reduction steps must be included in all alternatives for oversized solid wastes to be consolidated into Impoundment 8.

28. Section 4.3.4.6, Page 4-42, Item 2: Define "Limited Backfill".

29. Section 4.3.4.6, Page 4-45, Item 5: Describe and specify the treatment for discharged gases throughout the document.

30. Section 4.3.4.6, Page 4-47, Last Item: Is this ground water or leachate?

31. Section 4.3.4.6, Page 4-49, Item 9: Collected ashes from off-site incinerator to Impoundment 8 for disposal must meet the applicable regulatory standards and strength requirements.

32. Section 4.3.4.6, Page 4-50, Item 10: Off-site treatment and disposal must meet the LDR UTS.

33. Section 4.4.1, Page 4-52, Paragraph 1: It is stated that on-site incineration can be screened out as likely unimplementable due to lack of community acceptance. Please revise to read: On-site incineration can be screened out due to past opposition from community.

34. Section 5, General: Detailed evaluation provided for remedial alternatives is very generic. For example, in Alternative 4 evaluation against Action-Specific ARARs, it is stated that this alternative would be required to meet the treatment unit standards (page 5-28). What does this mean? Evaluation must be provided as to what are ARARs for the alternative being evaluated, whether the alternative achieves the ARARs/Criterion, and if it does, how. All alternatives must be evaluated in detail by providing specifics as to whether the alternatives meets the criterion and if it does, then how. There is no need to provide redundant description of alternatives and its requirements in the detailed evaluation section.

35. Section 5.1, Page 5-2, Paragraphs 1 and 2: Delete third sentence of paragraph 1 and last half of sentence 1 of paragraph 2.

36. Section 5.1, Page 5-2, Item 1: Should be revised to read: This criterion provides an evaluation of how an alternative adequately protects human health and the environment, in both short-term and long-term, from unacceptable risks posed by hazardous substance, pollution or contamination at the site by eliminating, reducing or controlling exposures.

37. Section 5-1, Page 5-3, Item 4: Add the word "treated or recycled" after the word "destroyed" in the last sentence.

38. Section 5-1, Page 5-4, Items 8 and 9: Revise to read: Satisfaction of these criteria will be determined during the process of Proposed Plan, Public Comment Period and Record of Decision.

39. Section 5-1, Page 5-4, Last Sentence: The word "screened" should be replaced with "evaluated".

40. Section 5.2.1, Page 5-5: Delete the specifics of ground water monitoring program from here and throughout the document. See comment # 26 above.

41. Section 5.2.2.1, Page 5-9: Delete the word " potentially" in the first sentence.

42. Section 5.2.2.2, Page 5-12, Chemical-Specific ARARs: Pending CAMU designation for Impoundment 8, LDR UTS are ARARs for all treatment alternatives. Revise throughout the document.

43. Section 5.2.2.2, Page 5-12, Item 1: Delete the entire discussion of CAMU/TCLP throughout the document.

44. Section 5.2.2.2, Page 5-12, Item 2: It is stated that if the underlying soils are below ground water, the NJDEP SCC would not apply. This is incorrect. In this case, the NJDEP Impact to Ground Water SCC would apply.

45. Section 5.2.2.5, Page 5-15, Paragraph 2: Provide details of the gas treatment devices.

46. Section 5.2.2.5, Page 5-15, Last Paragraph: Delete the first five lines of this paragraph here and throughout the document.

47. Section 5.2.2.6, Page 5-16: It is stated that if ground water were encountered during the excavation, it would be addressed. Please explain how.

48. Section 5.2.7, Page 5-57: Inorganic contaminants must also be addressed as part of this alternative.

49. Section 5.2.7.5, Page 5-63, Paragraph 2: Should be revised to read: Transportation to an off-site facility of large volumes of waste materials would significantly increase the risk to human health and the environment by accidental release.

50. Section 5.2.7.5, Page 5-63, Paragraph 3: This is an independent alternative from disposal into Impoundment 8. As such, it can be implemented sooner than estimated.

51. Section 6.2, Page 6-2, Item 3: The recommended alternative does not satisfy the ARARs (LDR UTS or Alternate Levels of Superfund 6A).

52. Table 4.3.1: Delete CAMU petition from the list of TBCs. Include a statement under Chemical-Specific ARARs that Treatment Levels will be as specified in the CAMU designation (petition currently being reviewed by USEPA).

53. Table 4.4.1: Add a statement in Item 4, Column 2 that the Treatment Levels will be as specified in the CAMU designation.

54. Table 4.4.4: Delete the reference for CAMU petition.

If you have any questions, please contact me at (609) 633-1455.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Sharon Jaffess, USEPA-SUPERFUND

Exhibit B

NJDEP comment letters and AHPC response letter on April 1996 Group III CMS/FS Report

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

JUL 15 1996

CERTIFIED MAIL
RETURN RECEIPT REQUESTED P 349 581 165
NO.

Patricia Wells McDonald, Manager-Environmental Affairs
American Home Products Corporation
Department of Environment & Safety
Five Giralda Farms
Madison, NJ 07940

Dear Ms. McDonald:

Re: American Home Products Corporation/American Cyanamid Company Site
Bridgewater Township, Somerset County

The New Jersey Department of Environmental Protection (NJDEP) and the United States Environmental Protection Agency (USEPA) have reviewed the Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS) Report dated April 1996 (received on May 1, 1996), prepared by O'Brien & Gere. NJDEP and USEPA comments are as follows:

1. Section 1.1, Page 1-2, Paragraph 2: Last sentence must be revised to read: "The use of Impound 8... by eliminating the migration of constituents to air, soil or ground water and **surface water**."

2. Section 1.1, Page 1-2, Paragraph 3: Second sentence must be revised to read: "Disposal of materials... to hazardous substances that **are** present in the Group III impoundment material."

3. Section 1.1, Page 1-2, Paragraph 3: Third sentence must be revised to read: "The design for Impound 8 exceeds... including an impermeable cap, multiple liners, a leachate **detection and** collection system, a ground water intercepter trench, and a ground water monitoring system."

4. Section 1.1, Page 1-3, Paragraph 1: Delete word "potentially" from the second sentence.

5. Section 2.2.2, Page 2-6, Paragraph 1: It is stated that the ground water pumped is treated to meet New Jersey Pollutant Discharge Elimination System (NJPDES) permit effluent limitations before being discharged to Somerset Raritan Valley Sewage Authority (SRVSA). Is this NJPDES permit still valid? Also, describe the type of ground water treatment being performed.

6. Section 2.2.2, Page 2-6, Paragraph 2: It is stated in second sentence that the ground water monitoring at the site have confirmed that the ground water control system is effectively controlling the majority of the impacted bedrock ground water at the site. This is partially incorrect. The impacted bedrock ground water is being controlled only on the main plant and west yard areas of the site and not on the entire site.

7. Section 2.4, Page 2-8, Paragraph 1: First sentence must be revised to read: "Based on the findings of the Baseline Endangerment Assessment, the Group III impoundments, **with the exception of Impoundments 1 and 2,** do not pose... in their current state."

8. Section 2.4, Page 2-8, Last Paragraph: Delete word "potential" from Line 2. Also, add the following sentence in this section: While the Endangerment Assessment concluded there was limited potential for direct contact with the material in the Group III Impoundments, this material is a continuous source of ground water contamination.

9. Section 2.6, Page 2-10, Paragraph 2: It is stated that metals data are not summarized because historical data generally indicated that metals are not a regulatory issue of concern. This is incorrect. Metals detected in the Group III Impoundments are of regulatory concern. As such, a summary of metal data must be included for each impoundment in sections 2.6.1 through 2.6.8. In addition, include a summary table (similar to one presented in Exhibit F) with all analytical data for all Group III Impoundments.

10. Section 2.6.4, Page 2-15, Paragraph 1: Specify size and depth of Impoundment 4.

11. Section 2.6.5, Page 2-16, Paragraph 1: Specify depth of Impoundment 5.

12. Section 2.6.8, Page 2-20, Paragraph 1: Specify depth of Impoundment 26.

13. Section 2.6.9, Page 2-22, Bullet Item 4: Describe how it was determined that materials of Impoundment 5 (Dry) and Impoundment 26 are non-hazardous fill.

14. Section 3.1, Page 3-2, Paragraph 2: It is stated that potential chemical--specific Applicable or Relevant and Appropriate Requirements (ARARs) for the Group III impoundments were not identified. This is incorrect. Universal Treatment Standards (UTSs) specified under the Land Disposal Restrictions (LDRs) are chemical and action specific ARARs.

15. Section 3.1, Page 3-2, Bullet Item: It must be revised to read: "**Eliminate** the migration... to air, soil, ground water **and surface water**... in exceedances of ARARs."

16. Section 3.3, Page 3-3, Paragraph 1: If ground water is encountered first, before underlying soils, during removal of the Group III Impoundments, saturated soil sampling and remediation (if necessary) should be performed. This is appropriate because saturated soils may act as a continuous source of ground water contamination which is not consistent with the Remedial Action Objectives (RAOs) of eliminating the source of ground water contamination. Addressing soil contamination in the saturated zone would be cost effective in that it would improve ground water quality faster requiring less treatment of contaminated ground water. Currently, NJDEP would only recommend saturated zone contamination delineation because it is not a regulatory or statutory requirements. Please note that this requirement was proposed as part of February 20, 1996 Amendments to the Technical Requirements for Site Remediation, NJAC 7:26E. Once this Amendment is promulgated, saturated zone contamination delineation will be a regulatory requirement. NJDEP policy dated December 22, 1995 and a relevant page of New Jersey Register dated February 20, 1996 (Amendments to Technical Requirements) were forwarded to you with my letter dated July 1, 1996 for Impoundment 11 Remedial Action Plan (RAP).

17. Section 3.3, Page 3-3, Paragraph 1: It is stated that investigation and management of the soils remaining after the removal actions will be the subject of a separate operable unit. If removal actions are performed, it would be appropriate, efficient and cost-effective to address the remaining soils before backfilling of the impoundments.

18. Section 3.4.1, Page 3-4, Paragraph 1: Any material to be disposed in the Impoundment 8 Facility must be appropriately sized so as not to impact the liner system and must be compatible with the liner system.

19. Section 4.2.1, Page 4-2, Low-Temperature Thermal Treatment (LTTT): Second sentence must be revised to read: "LTTT would... **eliminating** migration of contaminants to ground water and **eliminating** public and environmental contact with the material." In addition, third sentence should be deleted in this section because there is not enough ecological impacts information to substantiate it. The same revisions should be made for On-site Incineration in this section as well as Bioremediation, LTTT and On-site incineration in Section 4.2.2 and LTTT and On-site Incineration in Section 4.2.3.

20. Section 4.2.5, Page 4-7, General Plant Debris: Size reduction (2 inches or less) must be part of all remedial alternatives considered for the cleaned debris prior to placement in the Impoundment 8 Facility due to potential impact to the Impoundment 8 liner system. Please refer to my July 1, 1996 letter for Impoundment 11 RAP for detailed discussion on this issue.

21. Section 4.3, Pages 4-7 & 4-8: Since solidification was not determined to be applicable for organics treatment for any of the Group III Impoundments, it should not be carried through into Detailed Analysis. It should be noted in Section 4 that solidification, while not effective for organics, will be retained only as secondary treatment, for residuals.

    Treatment alternatives must be developed and evaluated for remediation of materials in Impoundments 5 (dry) and 26. This is necessary because they contain high levels of contaminants.

22. Section 5, General: Treatment objectives for metals must be established.

23. Section 5.1, Page 5-1, Paragraph 1: In Sentence # 1, word "will" should be replaced with "may". Delete the entire Sentence # 5 because additional treatment of the material prior to disposal does provide further risk reduction in terms of long-term effectiveness and migrational potential. Delete the word "However" from Sentence # 6. Delete words "and redundancy" from Sentence # 7. Delete entire Sentence # 8.

24. Section 5.1, Page 5-1, Paragraph 2: First two sentences must be combined and then revised to read: "To designate Impoundment 8 as a Corrective Action Management Unit (CAMU), the EPA Regional Administrator must determine that... for any wastes remaining within a CAMU (58 CFR 8668)."

25. Section 5.1, Page 5-2, Last Paragraph: Debris must be steamed cleaned and reduced in size (See Comment # 20) prior to placement in the Impoundment 8 Facility.

26. Section 5.2.1, Page 5-3, Last Paragraph: Treatment objectives must be based on percent reduction levels of contaminants or contaminant groups and not based on a processing time frame of three weeks as proposed; significant additional concentration reductions were achieved after 15 weeks of processing time.

27. Section 5.2.1, Page 5-4, Last Paragraph: See Comment # 25 for the Last Sentence.

28. Section 5.2.2, Page 5-6, Last Paragraph: Performance evaluation must be based on percent reduction levels of contaminants or contaminant groups and not based on specific temperature and retention time as proposed.

29. Section 5.3, Page 5-7: Was Universal Treatment Standards (UTSs) and UTSs variance comparison performed based on maximum retention time and temperature for LTTT, and maximum processing time (as evaluated in the treatability study) for biotreatment? If not, it must be done that way.

The analysis of treatability studies compared to Treatability Variance Levels (TVLs), as requested, appears to be incomplete. Apparently, treatability study results were compared to the levels required by the "Superfund 6A Guidance", but only selectively. For example, for some of the contaminants which the report claims did not meet the 6A reduction requirements (nitrobenzene, 4-methylnaphthalene, naphthalene), the achievable treatability level cited was the HIGHEST level from the biotreatment studies. The treatability study results must be compared to 6A levels for all technologies, and not solely the one that performed the worst. Based on this, NJDEP and USEPA do not concur with the conclusion that the TVLs could not be consistently achieved. A more through analysis must be presented. This could be presented by impoundment, or by technology. The achievable treatment objectives will be a major issue in determining whether a CAMU is appropriate.

30. Section 5.4, Page 5-7, First Paragraph: Delete the Second Sentence.

31. Section 5.4, Page 5-8, Paragraph 2: Full-scale treatment objectives must be developed based on the lowest attainable levels from both LTTT and bioremediation pilot studies. Achievable treatment levels under LTTT could be orders of magnitude lower than Biotreatment.

32. Section 5.4, Page 5-9, Analytical Method Variability: Use lower limit of 10% for scale-up to establish the compliance limit for the full scale treatment system.

33. Section 5.4, Page 5-9, Last Paragraph: See Comment # 31.

34. Section 5.4, Page 5-10, Table: This table must be revised to incorporate Comment # 31. The table should also be revised to add one more column for percent reduction of contaminants listed.

35. Section 5.5, Page 5-10: See comment # 21.

36. Section 5.6, Page 5-11, Paragraph 2: Second half of the Sentence # 6 must be deleted.

37. Section 5.7, Page 5-12: Based on the above comments, NJDEP and USEPA do not agree with the treatment objectives specified in this section.

38. Section 6, General: Metals must be addressed as part of remedial alternatives evaluated.

39. Section 6, General: For each alternative, the excavation is described as being to the "top of ground water" or "six inches below the impoundment materials". This may not achieve remedial action objectives, if source material remains behind. The excavation must continue until material achieves the established cleanup levels. This may necessitate provisions to dewater the excavation.

Also, for each alternative, the time to implement must be provided (this will facilitate comparison of the short-term effectiveness). The current time frame provided in Section 8 are unclear (i.e., a range from 2-5 years for LTTT), so it would be helpful if the description of the alternatives included an estimate as well as an explanation of anticipated implementation times. The time required to implement a biotreatment alternative must also be considered in the context of our comment regrading the proposed 3-week treatment time (for example, if treatment is extended to 9 weeks, then would the time to implement the biotreatment alternatives be tripled?)

40. Section 6.1.2, Page 6-2, Material Handling: Describe type of handling unit. It is stated that the material would be excavated to the top of ground water. See comment # 16. Temporary staging area must have an enclosed structure with air emission monitoring, control and treatment. Incorporate this comment for all categories of all Group III Impoundments.

41. Section 6.1.2, Page 6-2, Conditioning: Describe type of conditioning unit. Incorporate this comment for all categories of all Group III Impoundments.

42. Section 6.1.2, Page 6-2, Site Restoration: After excavation, all Group III Impoundments must be backfilled to prior surface level and not to above the ground water level as proposed. Incorporate this comment for all categories of all Group III Impoundments.

43. Section 6.2.3, Page 6-8, Paragraph 1: How would the remaining (from recycling) finished compost be addressed/disposed?

44. Section 6.4, Page 6-15: As commented previously, treatment alternatives must be developed and evaluated for Category D material, Impoundments 5 (dry) and 26. It may be misleading to name the material in these impoundments as "non-hazardous fill". Although, these impoundments may not be classified as hazardous waste under RCRA, they do contain high levels of contaminants.

45. Section 6.5, Page 6-17, Material Handling: See Comments 18 and 20.

46. Section 7.1, Page 7-1, Chemical Specific--ARARs: Delete the text after the first three sentences in this section. UTSs are chemical--specific ARARs that will be triggered if the waste is removed from the Group III Impoundments for disposal elsewhere (including Impoundment 8). There are three possible ways to comply with this requirements; 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels) or 3) granting a CAMU and developing alternate treatment standards (also see Table 7-1 and revise accordingly). This section should state that the compliance with ARARs will be achieved in one of these three manners. Use the same language in Section 7.3 and in Section 8 under Compliance with ARARs.

47. Section 7.1, Page 7-1, Location--Specific ARARs: Cultural Resource and Stream Encroachment are ARARs for Impoundments 1 and 2.

48. Section 7.3, Page 7-2, Last Paragraph: Delete the first sentence and replace it as follows: LDRs and UTSs are potential ARARs for management of wastes for Group III Impoundments. However, Impoundment 8 may be designated as a CAMU, LDRs and UTSs may not be triggered.

49. Section 7.3, Page 7-3, Last Paragraph: Include a statement here that the revised CAMU petition was submitted to USEPA in May 1996.

50. Section 8, General: Metals, as previously commented, must be addressed as part of remedial alternatives evaluated.

51. Section 8, General: Under Long-term Effectiveness and Permanence, as well as Reduction of Toxicity, Mobility or Volume, throughout this section, the treatment alternatives (Biotreatment, LTTT and Incineration) must be compared in terms of relative degrees of risk and toxicity reduction. For example, LTTT treatability studies showed significantly higher percentage removal of contaminants than biotreatment. This would impact the relative long-term effectiveness, since

the residual risk is much lower with placement of LTTT residuals into Impoundment 8. Similarly, it must be stated that the LTTT alternative provides greater toxicity reduction.

52. Section 8, Page 8-1, Second Paragraph: Delete second half of the second sentence. In the last sentence, add words ", among alternatives," between words "evaluation" and "designed".

53. Section 8.1, Page 8-2, Overall Protection of Human Health and the Environment: In the first sentence, add word "eliminates or" between words "alternative" and "reduces". Replace word "improvement" with words "adequate protection" in the second sentence.

54. Section 8.1, Page 8-3, Reduction of Toxicity, Mobility or Volume through Treatment: In the last sentence, add words "treated or recycled" between words "waste" and "destroyed".

55. Section 8.1, Page 8-3, Implementability: In the first sentence, add words " and administrative" between words "technical" and "feasibility".

56. Section 8.1, Page 8-3, Agency Acceptance: Replace word "agency" with "USEPA" in the heading. Follow this for all alternatives in all material categories.

57. Section 8.2.2, Page 8-4, Overall Protection of Human Health and the Environment: Delete sentences 3 and 4. Follow this for all material categories.

58. Section 8.2.2., Page 8-5, Compliance with ARARs: See previous comments about LDRs and UTSs. Describe ARARs for each alternative being considered. Then provide comparative analysis among alternatives as to whether alternatives meet the ARARs and if yes, how. Follow this approach for all alternatives in all material categories.

59. Section 8.2.2, Page 8-6, Reduction of Toxicity, Mobility or Volume through Treatment: Only Alternatives A3 and A4 are permanent and not Alternative A2 as stated. Delete the first three sentences and replace with a statement that Alternative 1A does not include any treatment and therefore, there is no reduction of toxicity, mobility or volume. Also, the reasons for volume increase/decrease must be specified, here and in the following sections.

60. Section 8.2.2, Page 8-6, Short-term Effectiveness: Include the following in this section: Alternative A1 achieves this criterion better than any other alternatives because it can be implemented immediately. Alternative A2 is better than Alternatives A3 and A4 because it can achieve the RAOs in a shorter time frame than Alternatives A3 and A4. Follow this analysis for all material categories.

61. Section 8.2.2, Page 8-6, Implementability: Delete second half of Sentence 2. Follow this for on-site incineration alternatives for all material categories.

62. Section 8.2.2, Page 8-7, Community Acceptance: Delete the text here and replace with the following: Community and local government are opposed to on-site incineration. Follow this for on-site incineration alternatives for all material categories.

63. Section 8.2.2, Page 8-7, Cost: It must be stated in the cost comparison sections that because the impoundments were broken into groups for analysis of remedial alternatives, the costs were calculated independently and therefore may be overstated. For example, the cost of Alternative C3 (LTTT) for Impoundment 3 is approximately $10,000,000. However, approximately 40% of the cost is for mobilization of equipment. If LTTT alternatives were selected for Category A Impoundments, then the cost of Alternative C3 would be greatly reduced.

64. Section 8.3.2, Page 8-9, Reduction of Toxicity, Mobility or Volume through Treatment: Alternative B2 is not considered permanent contrary to what is stated in Sentence 4. In Sentence 6, it is stated that Alternative B4 (LTTT) would have a net material volume increase of approximately 4%. In Category A, it is stated that LTTT provides for 25% net volume increase. Please explain.

65. Section 8.4.2, Page 8-13, Reduction of Toxicity, Mobility or Volume through Treatment: It is stated that Alternative C2 (Consolidation in Impoundment 8) includes removal of the materials as an active treatment technology. This is incorrect. Neither removal nor consolidation in Impoundment 8 is considered active treatment.

    It is stated that Alternative C3 (LTTT) would result in no net volume increase. For Material Categories A and B, it is stated that LTTT would result in 25% and 4%, respectively, net volume increase. Please explain.

66. Section 8.4.2, Page 8-14, Cost: Alternative C4 is more expensive than Alternative C3.

67. Section 8.5, Page 8-15, category D: As stated previously, treatment alternatives must be developed and evaluated. Also, as stated previously, delete the reference of this material as "non-hazardous fill". It is misleading.

68. Section 8.5.2, Page 8-15, Overall Protection of Human Health and the Environment: Add a statement that Alternative D1 would not satisfy this criterion.

69. Section 8.5.2, Page 8-16, Long-term Effectiveness and Permanence as well as Reduction of Toxicity, Mobility or Volume: Include a statement that Alternative D2 achieves these criterion better than Alternative D1.

70. Section 8.5.2, Page 8-17, Cost: Revise the last sentence to read: "Alternative D2 is more expensive than Alternative D1."

71. Section 9, General: NJDEP and USEPA do not concur with the recommended alternatives based on the comments specified above.

72. Section 9.2, Page 9-2: Change the order of bullet items (3 to 1 and 1 to 3).

73. Section 9.2, Page 9-3, Paragraph 1: Delete word "potential" from Lines 6 and 11. Group III Impoundments have been confirmed to present a continuing source of ground water contamination.

74. Section 9.3, Page 9-3, Paragraph 1: Delete the entire paragraph prior to Bullet Items.

75. Section 9.3, Page 9-3, Bullet Item 1: It should be listed at the end of Bullet Items.

76. Section 9.3, Page 9-3, Bullet Item 2: Based on the treatability data, bioremediation would not remove the compounds of concern as efficiently (it does not reduce contaminants concentration as low as thermal) as the thermal treatment options for material category B.

77. Section 9.4, Pages 9-4 and 9-5: Delete the entire sections 9.4.1 through 9.4.4. They are redundant.

78. Section 9.4.2, Page 9-4, Long-term Effectiveness: Provide explanation for the phrase "landfill-like" materials.

79. Table 7-1: See previous comments about ARARs.

80. Attachment 1 to Exhibit G, Volume 1, Page G1-1, Toxicity: Part of Impoundment 8 Facility has already been constructed. Ground water in the vicinity of the Impoundment 8 Facility is not contained by a pump and treat system. It is contained by an intercepter trench.

81. Attachment 1 to Exhibit G, Volume 1, Page G1-2, Concentration: If a chemical was detected in a given impoundment, half of detection limit for that chemical should be used in accordance with the USEPA's Superfund Risk Assessment Guidance.

82. Volume 2, Appendix A, Section 2.6.1, Page 2-52, Last Paragraph: Describe the other effective means of decontamination.

83. Volume 2, Appendix A, Section 5.2.5, Page 5-5, Last Paragraph: The rate of water addition required to optimize material strength must be determined during remedial design.

84. Volume 2, Appendix A, Sections 5.2.5, Page 5-6, First Paragraph: Additional bench-scale studies, recommended in this section, to identify appropriate admixtures and addition rates needed to increase the unconfined compressive strength required for disposal in Impoundment 8 Facility must be carried out during remedial design. If strength criteria cannot be met, the treated material may have to be disposed off-site.

85. Volume 2, Appendix A, Sections 5.2.6, Page 5-6: As specified, the quantity and type of residuals must be evaluated for disposition during remedial design. If appropriate means of on-site disposal is not available, off-site disposal may be required.

86. Volume 2, Appendix A, Sections 5.2.7, Page 5-6: As recommended in this section, the issue of heavy organics condensation in the vent lines must be addressed during remedial design.

87. Volume 2, Appendix A, Sections 5.2.8, Page 5-7, Paragraph 1: Unless prior approval is obtained from the SRVSA, the option of discharging the treated water to the Publicly Owned Treatment Works (POTW) cannot be considered.

88. Volume 3, Appendix B, Section 3.1, Page 3-3, Paragraph 2: Provide description of excavation for Impoundment 14. Also, both Figures 3-14 and 3-15 reference Impoundment 14. This is incorrect. Please revise.

89. Volume 3, Appendix B, Section 3.2, Page 3-9, Paragraph 1: Optimization of sawdust amendment must be evaluated during remedial design.

Please revise and re-submit the CMS/FS Report incorporating the above comments within 45 calendar days after receipt of this letter.

If you have any questions, please contact me at (609) 633-0718.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Janet Feldstein, USEPA-SUPERFUND
Jim Hacklar, USEPA-SUPERFUND

O'BRIEN & GERE
ENGINEERS, INC.

September 13, 1996

Mr. Haiyesh Shah
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Federal Case Management
Division of Responsible Party Site Remediation
401 East State Street, 5th Floor West
CN 028
Trenton, New Jersey 08625-0028

Re: American Cyanamid Site
Bound Brook, New Jersey
Group III CMS/FS Report
Response to Comments

File: 5772.010 #11

Dear Mr. Shah:

This letter provides the responses to the agency comments on the Group III Corrective Measures Study/Feasibility Study (CMS/FS) Report (O'Brien & Gere, April 1996) for the American Cyanamid Site in Bound Brook, New Jersey. The comments were received in your letter dated July 15, 1996. The responses are based on the information presented at our meeting of August 14, 1996 and follow-up conference call of August 28, 1996. As previously discussed and agreed upon, the intent of the letter is to present the responses for regulatory review prior to revising the Group III CMS/FS report. Upon receipt of agency concurrence we will develop a schedule for finalizing the CMS/FS as discussed below.

Following is a summary of the individual comments and AHPC responses. In addition to the comments from the July 15, 1996 letter, two additional comments received during the above referenced conference call are also addressed and are presented following the written comments.

Comment 1. Section 1.1, Page 1-2, Paragraph 2: Last sentence must be revised to read: "The use of impound 8 . . . by eliminating the migration of constituents to air, soil or ground water and surface water."

Response: The Group III CMS/FS will be revised accordingly.

Comment 2. Section 1.1, Page 1-2, Paragraph 3: Second sentence must be revised to read: "Disposal of materials . . . to hazardous substances that are present in the Group III impoundment material."

Response: The Group III CMS/FS will be revised accordingly.

Comment 3. Section 1.1, Page 1-2, Paragraph 3: Third sentence must be revised to read: "The design for impound 8 exceeds... including an impermeable cap, multiple liners, a leachate detection and collection system, a ground water intercepter trench, and a ground water monitoring system."

Response: The Group III CMS/FS will be revised accordingly.

Comment 4. Section 1.1, Page 1-3, Paragraph 1: Delete word "potentially" from the second sentence.

Response: The Group III CMS/FS will be revised accordingly.

Comment 5. Section 2.2.2, Page 2-6, Paragraph 1: It is stated that the ground water pumped is treated to meet New Jersey Pollutant Discharge Elimination System (NJPDES) permit effluent limitations before being discharged to Somerset Raritan Valley Sewage Authority (SRVSA). Is this NJPDES permit still valid? Also, describe the type of ground water treatment being performed.

Response: As required by the Administrative Consent Order (ACO), ground water is withdrawn from the on-site production wells at a rate not less than 650,000 gpd. The recovered ground water is combined with the plant's production wastewater, pretreated by neutralization and discharged to the SRVSA under an existing permit (SRVSA Permit No. 8A).

Comment 6. Section 2.2.2, Page 2-6, Paragraph 2: It is stated in second sentence that the ground water monitoring at the site has confirmed that the ground water control system is effectively controlling the majority of the impacted bedrock ground water at the site. This is partially incorrect. The impacted bedrock ground water is being controlled only on the main plant and west yard areas of the site and not on the entire site.

Response: The Group III CMS/FS will be clarified accordingly.

Comment 7. Section 2.4, Page 2-8, Paragraph 1: First sentence must be revised to read: "Based on the findings of the Baseline Endangerment Assessment, the Group III impoundments, with the exception of impoundments 1 and 2, do not pose . . . in their current state."

Response: The risk level of 2.4×10^{-6} presented in the Baseline Endangerment Assessment is only slightly above the 1×10^{-6} guideline and is well within the USEPA 1×10^{-4} guideline. Therefore, the statement within the CMS/FS that Impoundments 1 and 2 do not pose an unacceptable risk in their current state is appropriate and will be retained.

Comment 8. Section 2.4, Page 2-8, last paragraph: Delete word "potential" from Line 2. Also, add the following sentence in this section: While the Endangerment Assessment concluded there was limited potential for direct contact with the material in Group III Impoundments, this material is a continuous source of ground water contamination.

Response: The Group III CMS/FS will be revised to delete "potential" from line 2. However, the sentence that is added will be modified to state that the material is a *probable* continuous source of ground water contamination.

Comment 9. Section 2.6, Page 2-10, Paragraph 2: It is stated that metals data are not summarized because historical data generally indicated that metals are not a regulatory issue of concern. This is incorrect. Metals detected in the Group III Impoundments are of regulatory concern. As such, a summary of metal data must be included for each impoundment in sections 2.6.1 through 2.6.8. In addition, include a summary table (similar to one presented in Exhibit F) with all analytical data for all Group III Impoundments.

Response: The CMS/FS will be revised to state that although metals are a regulatory concern, they are not considered a concern with respect to treatment since less than 0.5% of the contamination in the Group III material is comprised of metals. Additionally, the majority of the TCLP data collected from the Group III impoundments are below the regulatory limits.

Attachment 1 to this letter provides a summary of the available metal data as it will be presented in Sections 2.6.1 through 2.6.8 of the revised CMS/FS. In addition, Exhibit F of the CMS/FS will be revised to incorporate a summary of the complete available laboratory data set for each Group III impoundment.

Comment 10. Section 2.6.4, Page 2-15, Paragraph 1: Specify size and depth of Impoundment 4.

Response: Impoundment 4 encompasses an area of approximately one acre. The impoundment originally contained between 7 and 9 feet of tar material, prior to the removal of 12,500 yd^3 of tar during the Fuel Blending/Recycling Program. Approximately 1,000 yd^3 remain. The Group III CMS/FS will be revised accordingly.

Comment 11. Section 2.6.5, Page 2-16, Paragraph 1: Specify depth of Impoundment 5.

Response: The impoundment has a total average depth of approximately 12 feet. The Group III CMS/FS will be revised accordingly.

Comment 12. Section 2.6.8, Page 2-20, Paragraph 1: Specify depth of Impoundment 26.

Response: The average depth of Impoundment 26 is approximately 14 feet. The Group III CMS/FS will be revised accordingly.

Comment 13. Section 2.6.9, Page 2-22, Bullet Item 4: Describe how it was determined that materials of Impoundment 5 (Dry) and Impoundment 26 are non-hazardous fill.

Previous classification by the New Jersey Department of Environmental Protection (NJDEP) determined that the materials were not hazardous wastes. Attachment 2 to this letter provides the associated correspondence. Additionally, previous correspondence (original Group III CMS/FS, Blasland, Bouck & Lee, May 1995) stated that the material was below TCLP limits without treatment. It was noted and understood that additional sampling and analyses may be required to verify the classification. The main intent of the CMS/FS, however, is to include a category for non-hazardous materials which do not require treatment. Classification efforts based on TCLP will be incorporated into the remedial design phase.

Comment 14. Section 3.1, Page 3-2, Paragraph 2: It is stated that potential chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) for the Group III impoundments were not identified. This is incorrect. Universal Treatment Standards (UTSs) specified under the Land Disposal Restrictions (LDRs) are chemical and action specific ARARs.

Response: This will be clarified (consistent with Comment 48) that UTSs and LDRs are potential action-specific ARARs, but would not be triggered if Impound 8 is designated as a CAMU. We do not interpret UTS and LDR standards as chemical-specific, since they are contingent on the remedial action applied to the materials.

Comment 15. Section 3.1, Page 3-2, Bullet Item 1: It must be revised to read: "Eliminate the migration . . . to air, soil, ground water and surface water . . . in exceedances of ARARs."

Response: The Group III CMS/FS will be revised accordingly.

Comment 16. Section 3.3, Page 3-3, Paragraph 1: If ground water is encountered first, before underlying soils, during removal of the Group III Impoundments, saturated soil sampling and remediation (if necessary) should be performed. This is appropriate because saturated soils may act as a continuous source of ground water contamination which is not consistent with the Remedial Action Objectives (RAOs) of eliminating the source of ground water contamination. Addressing soil contamination in the saturated zone would be cost effective in that it would improve ground water quality faster requiring less treatment of contaminated ground water. Currently, NJDEP would only recommend saturated zone contamination delineation because it is not a regulatory or statutory requirement. Please note that this requirement was proposed as part of February 20, 1996 Amendments to the Technical Requirements for Site Remediation, NJAC 7:26E. Once this Amendment is promulgated, saturated zone contamination delineation will be a regulatory requirement. NJDEP policy dated December 22, 1995 and a relevant page of New Jersey Register dated February 20, 1996 (Amendments to Technical Requirements) were forwarded to you with my letter dated July 1, 1996 for Impoundment 11 Remedial Action Plan (RAP).

Response: The intent of the remedial alternatives presented in the CMS/FS is to remove the impoundment contents, consisting of sludge plus 6 inches of underlying soil, regardless of the ground water level, and address potentially impacted soil remaining beneath the impoundments as a separate operable unit in accordance with the requirements of the ACO. Saturated soils are anticipated to be addressed as part of the ground water operable unit. This strategy is appropriate since the work conducted to date is not sufficient to determine the extent of contamination, evaluate or identify cleanup levels, or determine associated risks. Therefore, a determination of the most efficient, cost-effective method of remediation can not be made at this time.

With respect to Impoundment 1 and 2, impoundment contents and underlying soil will be removed to ground water level and the impoundments will be subsequently backfilled to surrounding grade level. This strategy is being employed to address safety issues associated with the impoundments location within the flood plain.

Comment 17. Section 3.3, Page 3-3, Paragraph 1: It is stated that investigation and management of the soils remaining after the removal actions will be the subject of a separate operable unit. If removal actions are performed, it would be appropriate, efficient, and cost-effective to address the remaining soils before backfilling of the impoundments.

Response: Please refer to the Response to Comment 16.

Comment 18. Section 3.4.1, Page 3-4, Paragraph 1: Any material to be disposed in the Impoundment 8 Facility must be appropriately sized so as not to impact the liner system and must be compatible with the liner system.

Response: The Group III CMS/FS will be revised accordingly. The placement of debris within the Impound 8 facility has been evaluated with respect to impacts to the liner system. The evaluations have shown that potential settlement of debris will not impact the liner integrity. These evaluations are summarized in a letter dated August 8, 1996 provided as Attachment 3 to this letter.

Comment 19. Section 4.2.1, Page 4-2, Low-Temperature Thermal Treatment (LTTT): Second sentence must be revised to read, "LTTT would . . . eliminating migration of contaminants to ground water and eliminating public and environmental contact with the material." In addition, third sentence should be deleted in this section because there is not enough ecological impact information to substantiate it. The same revisions should be made for On-site Incineration in this section as well as Bioremediation, LTTT and On-site incineration in Section 4.2.2 and LTTT and On-site incineration in Section 4.2.3.

Response: The second sentence will be revised to reflect the NJDEP's comment. The third sentence should not be deleted, however, but clarified. The intent of this sentence is that the risk reduction associated with ultimate placement of the material into Impound 8 is enhanced by treatment of the material. The third sentence will, therefore, be revised as follows:

"Treatment would enhance the already reduced risk through a reduction in contaminant levels."

Comment 20. Section 4.2.5, Page 4-7, General Plant Debris: Size reduction (2 inches or less) must be part of all remedial alternatives considered for the cleaned debris prior to placement in the Impoundment 8 Facility due to potential impact to the Impound 8 liner system. Please refer to my July 1, 1996 letter for Impoundment 11 RAP for detailed discussion on this issue.

Response: Please refer to the Response to Comment 18.

Comment 21. Section 4.3, Pages 4-7 and 4-8: Since solidification was not determined to be applicable for organics treatment for any of the Group III Impoundments, it should not be carried through into Detailed Analysis. It should be noted in Section 4 that solidification, while not effective for organics, will be retained only as secondary treatment, for residuals.

Treatment alternatives must be developed and evaluated for remediation of materials in Impoundments 5 (dry) and 26. This is necessary because they contain high levels of contaminants.

Response: The Group III CMS/FS will be clarified with respect to solidification. Solidification is not carried into the Detailed Analysis as a separate treatment technology. It is rather a secondary process within each alternative to condition residuals to meet the strength requirement for placement into Impound 8 and to further reduce the leachability of metals.

The evaluation of Material Category D - Non-hazardous *materials* will be expanded to include a treatment alternative as well as an off-site disposal alternative.

Comment 22. Section 5, General: Treatment objectives for metals must be established.

Response: As stated in the Response to Comment 9, although metals may be a regulatory issue of concern they are generally not leachable and are therefore not a concern with respect to treatment. The *treatment objective* for metals will be non-leachability as measured by TCLP analyses. Compliance with this objective will be established during the remedial design phase and may consist of the use of pre- or post-treatment analytical data.

Comment 23. Section 5.1, Page 5-1, Paragraph 1: In Sentence #4, word "will" should be replaced with "may." Delete the entire Sentence #5 because additional treatment of the material prior to disposal does provide further risk reduction in terms of long-term effectiveness and migrational potential. Delete the word "However" from Sentence #6. Delete words "and redundancy" from Sentence #7. Delete entire Sentence #8.

Response: Sentence 4, 6, 7, and 8 will be revised accordingly. However, sentence 5 will be deleted and replace with, "Use of a CAMU, and more importantly, disposal within this state-of-the-are, triple-lined facility, does not specifically require treatment. The use of treatment prior to placement only enhances an alternatives ability to meet the RAO by reducing risk to human health and the environment."

Comment 24. Section 5-1, Page 5-1, Paragraph 2: First two sentences must be combined and then revised to read: "To designate Impoundment 8 as a Corrective Action Management Unit (CAMU), the EPA Regional Administrator must determine that . . . for any wastes remaining within a CAMU (58 CFR 8668)."

Response: The Group III CMS/FS will be revised accordingly.

Comment 25. Section 5.1, Page 5-2, Last Paragraph: Debris must be steamed cleaned and reduced in size (See Comment #20) prior to placement in the Impoundment 8 facility.

Response: The Group III CMS/FS includes provisions for Best Management Practices to clean debris. It will be modified to state that these may include mechanical separation, steam cleaning, pressure washing, or other method, as necessary, to remove free sludge prior to placement in Impound 8. The specific methods will be evaluated and identified during the remedial design phase.

Comment 26. Section 5.2.1, Page 5-3, Last Paragraph: Treatment objectives must be based on percent reduction levels of contaminants or contaminant groups and not based on a processing time frame of three weeks as proposed: significant additional concentration reductions were achieved after 15 weeks of processing time.

Response: Specific treatment objectives for the bioremediation process have been developed based on the reduction of contaminant levels using the full nine weeks of processing data. Data produced subsequent to the nine week test, i.e., the 15 weeks referenced in the comment letter, was associated with a separate, confirmation phase of testing and is not representative of process results. The pilot test was completed after the nine weeks of processing. At that time, confirmation testing was conducted to evaluate the affects of mixing impoundment materials, which appeared to have the potential to provide an increase in microbial population. Additionally, the effects of heat and acclimation were evaluated with respect to rate of contaminant reduction. This testing was dissimilar and separate from the pilot program and the associated data can not be used in evaluating full-scale treatment.

The minimum levels achieved throughout the nine weeks of process were utilized in developing the treatment objectives. As per our discussions we have developed mutually agreeable treatment objectives consisting of a Maximum Compliance Value which would represent the highest concentration which could be disposed of in Impound 8, and an Average Compliance Value consisting of the average concentration over the monitoring period. Based on the heterogeneity of the materials, the monitoring period for average compliance is proposed as six months.

Attachment 4 presents a description of how the treatment objectives were developed, an example of how the values were calculated, and the presentation of the revised bioremediaton treatment objectives for the Category B material.

Comment 27. Section 5.2.1, Page 5-4, Last Paragraph: See Comment #25 for the Last Sentence.

Response: The Group III CMS/FS will be revised as described in the Response to Comment 26.

Comment 28. Section 5.2.2, Page 5-8, Last Paragraph: Performance evaluation must be based on percent reduction levels of contaminants or contaminant groups and not based on specific temperature and retention time as proposed.

Response: Specific treatment objectives for the low temperature thermal desorption process have been developed based on the reduction of contaminant levels using the full range of operating conditions. Data from processes which are not within the definition of low temperature thermal desorption, such as the SoilTech ATP process which approximates incineration and Weston data below 300 °F, were not included in the evaluation. The minimum levels achieved throughout the full range of operating conditions were utilized in developing the treatment objectives. Attachment 4 presents the revised low temperature thermal desorption treatment objectives for the Category A material.

Comment 29. Section 5.3, Page 5-7: Was Universal Treatment Standards (UTSs) and UTSs variance comparison performed based on maximum retention time and temperature for LTTT, and maximum processing time (as evaluated in the treatability study) for biotreatment? If not, it must be done that way.

The analysis of treatability studies compared to Treatability Variance Levels (TVLs), as requested, appears to be incomplete. Apparently, treatability study results were compared to the levels required by the "Superfund 6A Guidance", but only selectively. For example, for some of the contaminants which this report claims did not meet the 6A reduction requirements (nitrobenzene, 4-methylnaphthalene, naphthalene), the achievable treatability level cited was the HIGHEST level from the biotreatment studies. The treatability study results must be compared to 6A levels for all technologies, and not solely the one that performed the worst. Based on this, NJDEP and USEPA do not concur with the conclusions that the TVLs could not be consistently achieved. A more thorough analysis must be presented. This could be presented by impoundment, or by technology. The achievable treatment objectives will be a major issue in determining whether a CAMU is appropriate.

Response: The UTS and 6A Variance evaluation has been done separately for Group A and Group B categories. A detailed description of the basis of the evaluation is provided in Attachment 5 and will be included as a revision to Appendix E of the CMS/FS. Based on the evaluation, UTS and 6A Variance levels are not achievable; therefore, a CAMU is appropriate.

Comment 30. Section 5.4, Page 5-7, First Paragraph: Delete the Second Sentence.

Response: The second sentence will be revised to state, "As previously stated, *solidification to meet strength requirements followed by* placement of the material into the Impound 8 Facility, as a CAMU, meets the RAO for Group III."

Comment 31. Section 5.4, Page 5-8, Paragraph 2: Full-scale treatment objectives must be developed based on the lowest attainable levels from both LTTT and bioremediation pilot studies. Achievable treatment levels under LTTT could be orders of magnitude lower than Biotreatment.

Response: Full-scale treatment objectives for bioremediation and LTTT have been developed based on the lowest attainable levels from the respective pilot studies. Please refer to the Responses to Comments 26 and 28, and Attachment 4 for specifics.

Comment 32. Section 5.4, Page 5-9, Analytical Method Variability: Use lower limit of 10% for scale-up to establish the compliance limit for the full scale treatment system.

Response: Although the recognized range is 10 - 30%, the lower limit will be used per Agency request. The Group III CMS/FS will be revised accordingly.

Comment 33. Section 5.4, Page 5-9, Last Paragraph: See Comment #31.

Response: Please refer to the Response to Comment #31.

Comment 34. Section 5.4, Page 5-10, Table: This table must be revised to incorporate Comment #31. The table should also be revised to add one more column for percent reduction of contaminants listed.

Response: Please refer to the Response to Comment 31. The table will be revised accordingly.

Comment 35. Section 5.5, Page 5-10: See Comment #21.

Response: As clarified at the meeting of August 14, 1996, this comment actually refers to Comment #22. The Group III CMS/FS will be revised according to the response provided for Comment #22.

Comment 36. Section 5.6, Page 5-11: Paragraph 2: Second half of the Sentence #6 must be deleted.

Response: The Group III CMS/FS will be revised accordingly.

Comment 37. Section 5.7, Page 5-12: Based on the above comments, NJDEP and USEPA do not agree with the treatment objectives specified in this section.

Response: New treatment objectives have been developed based on our analyses and discussions with NJDEP and USEPA and are presented in Attachment 4.

Comment 38: Section 6, General: Metals must be addressed as part of remedial alternatives evaluated.

Response: Each of the remedial alternatives includes solidification prior to placement within the Impound 8 Facility. While the main purpose of this treatment is to meet strength requirements for placement, solidification also reduces the leachability of the metals. For this reason, metals are addressed as part of each remedial alternative. TCLP limits will be evaluated as part of pre-treatment and/or post-treatment data. The Group III CMS/FS will be revised to clarify this.

Comment 39. Section 6, General: For each alternative, the excavation is described as being to the "top of ground water" or "six inches below the impoundment materials". This may not achieve remedial action objectives, if source material remains behind. The excavation must continue until material achieves the established cleanup levels. This may necessitate provisions to dewater the excavation.

Also, for each alternative, the time to implement must be provided (this will facilitate comparison of the short-term effectiveness). The current time frame provided in Section 8 are unclear (i.e., a range from 2-5 years for LTTT), so it would be helpful if the description of the alternatives included an estimate as well as an explanation of anticipated implementation times. The time required to implement a biotreatment alternative must also be considered in the context of our comment regarding the proposed 3-week treatment time (for example, if treatment is extended to 9 weeks, then would the time to implement the biotreatment alternatives be tripled?)

Response: The excavation will continue until all of the impoundment material is removed, regardless of ground water. Please refer to the response to Comment No. 16.

A further explanation of the timeframes for each alternative will be provided in revised Section 8. Attachment 6 to this letter provides details on how the timeframes were established. Using the revised treatment objectives and the initial equipment sizing and throughputs, the timeframe for bioremediation is 5 - 7 years and the timeframe for LTTT is 3 - 4 years for Material Category B. These timeframes may be changed by varying equipment size and throughput rates.

Comment 40. Section 6.1.2, Page 6-2, Material Handling: Describe type of handling unit. It is stated that the material would be excavated to the top of ground water. See Comment #16. Temporary staging area must have an enclosed structure with air emission monitoring, control and treatment. Incorporate this comment for all categories of all Group III Impoundments.

Response: Please refer to previous response regarding excavation to ground water. Regarding the temporary staging area, the CMS/FS will be revised to state that the area will have appropriate air emission monitoring, control, and treatment as necessary, without specifying a specific *enclosed structure*.

Comment 41. Section 6.1.2, Page 6-2, Conditioning: Describe type of conditioning unit. Incorporate this comment for all categories of all Group III Impoundments.

Response: Designating the specific type of "conditioning unit" is not germane to the CMS/FS but is, rather, a remedial design issue. Specification of equipment will be developed as part of the remedial design phase of the program.

Comment 42. Section 6.1.2, Page 6-2, Site Restoration: After excavation, all Group III Impoundments must be backfilled to prior surface level and not to above the ground water level as proposed. Incorporate this comment for all categories of all Group III Impoundments.

Response: Specification of backfill requirements is contingent on a variety of issues such as remediation of underlying soils, safety, final site usage, and structural stability. These issues will be more appropriately addressed during the remedial action implementation phase and specific backfill details will be determined at that time. Currently, backfill to the ground water level is proposed for structural reasons.

Comment 43. Section 6.2.3, Page 6-6, Paragraph 1: How would the remaining (from recycling) finished compost be addressed/disposed?

Response: The Group III CMS/FS will be revised to reflect that all Group III materials will be placed into Impound 8.

Comment 44. Section 6.4, Page 6-12: As commented previously, treatment alternatives must be developed and evaluated for Category D material, Impoundments 5 (dry) and 26. It may be misleading to name the material in these impoundments as "non-hazardous fill." Although, these impoundments may not be classified as hazardous waste under RCRA, they do contain high levels of contaminants.

Response: As stated previously, the evaluation of Material Category D - Non-hazardous *Materials* will be expanded to include a bioremediation alternative and an off-site disposal alternative. Attachment 7 includes the description and detailed analysis of the alternatives. Based on this information the conclusions of the Group III CMS/FS for Material Category D which recommends consolidation into the Impound 8 Facility will remain the same.

Comment 45. Section 6.5, Page 6-17, Material Handling: See Comments 18 and 20.

Response: Please refer to the Response to Comment 18.

Comment 46. Section 7.1, Page 7-1, Chemical Specific-ARARs: Delete the text after the first three sentences in this section. UTSs are chemical-specific ARARs that will be triggered if the waste is removed from the Group III Impoundments for disposal elsewhere (including Impoundment 8). There are three possible ways to comply with this requirement: 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels) or 3) granting a CAMU and developing alternate treatment standards (also see Table 7-1 and revise accordingly). This section should state that the compliance with ARARs will be achieved in one of these three manners. Use the same language in Section 7.3 and in Section 8 under Compliance with ARARs.

Response: Please refer to the Response to Comment 14. This section of the Group III CMS/FS will be revised to state that compliance with ARARs can be achieved in one of the three ways specified. Based on the results of the pilot studies, since the treatment methods could not achieve UTSs or obtain the 6A Variance levels, granting of a CAMU and development of alternative treatment standards will be necessary.

Comment 47. Section 7.1, Page 7-1, Location-Specific ARARs: Cultural Resource and Stream Encroachment are ARARs for Impoundments 1 and 2.

Response: The Group III CMS/FS will be revised accordingly.

Comment 48. Section 7.3, Page 7-2, Last Paragraph: Delete the first sentence and replace is as follows: LDRs and UTSs are potential ARARs for management of wastes for Group III Impoundments. However, Impoundment 8 may be designated as a CAMU, LDRs and UTSs may not be triggered.

Response: The Group III CMS/FS will be revised accordingly.

Comment 49. Section 7.3, Page 7-3, Last Paragraph: Include a statement here that the revised CAMU petition was submitted to USEPA in May 1996.

Response: The Group III CMS/FS will be revised accordingly.

Comment 50. Section 8, General: Metals, as previously commented, must be addressed as part of remedial alternatives evaluated.

Response: Please refer to the Response to Comment 38.

Comment 51. Section 8, General: Under Long-term Effectiveness and Permanence, as well as Reduction of Toxicity, Mobility or Volume, throughout this section, the treatment alternatives (Biotreatment, LTTT and Incineration) must be compared in terms of relative degrees of risk and toxicity reduction. For example, LTTT treatability studies showed significantly higher percentage removal of contaminants than biotreatment. This would impact the relative long-term effectiveness, since the residual risk is much lower with placement of LTTT residuals into Impoundment 8. Similarly, it must be stated that the LTTT alternative provides greater toxicity reduction.

Response: According to a risk analysis conducted by Environ, the additional risk reduction from LTTT to Biotreatment levels is less than 0.5%. This is not a significant reduction of risk to justify the additional costs associated with LTTT. Attachment 8 to this letter provides the recalculation risk analyses based on the revised treatment objectives.

Additionally, the application of LTTT treatment objectives to the Category B material is not possible with the existing treatability data since LTTT pilot work was not conducted for those materials. Higher levels of SVOC compounds exist in the Category B materials which may not be removed by thermal treatment as well as the removal of lower concentrations of SVOCs which were in Category A treatability testing. Furthermore, the characteristics of the tar materials in Category B (for example, stringy and tacky tars in Impoundment 5) may present more difficult material handling and less efficient treatment.

Comment 52. Section 8, Page 8-1, Second Paragraph: Delete second half of the second sentence. In the last sentence, add words "among alternatives" between words "evaluation" and "designed."

Response: The Group III CMS/FS will be revised accordingly.

Comment 53. Section 8.1, Page 8-2, Overall Protection of Human Health and the Environment: In the first sentence, add word "eliminates or" between words "alterative" and "reduces." Replace word "improvement" with words "adequate protection" in the second sentence.

Response: The Group III CMS/FS will be revised accordingly.

Comment 54. Section 8.1, Page 8-2, Reduction of Toxicity, Mobility or Volume through Treatment: In the last sentence, add words "treated or recycled" between words "waste" and "destroyed."

Response: The Group III CMS/FS will be revised accordingly.

Comment 55. Section 8.1, Page 8-3, Implementability: In the first sentence, add words "and administrative" between words "technical" and "feasibility."

Response: The Group III CMS/FS will be revised accordingly.

Comment 56. Section 8.1, Page 8-3, Agency Acceptance: Replace word "agency" with "USEPA" in the heading. Follow this for all alternatives in all material categories.

Response: The Group III CMS/FS will be revised accordingly.

Comment 57. Section 8.2.2, Page 8-4, Overall Protection of Human Health and the Environment: Delete sentences 3 and 4. Follow this for all material categories.

Response: The Group III CMS/FS will be revised accordingly.

Comment 58. Section 8.2.2, Page 8-5, Compliance with ARARs: See previous comments about LDRs and UTSs. Describe ARARs for each alternative being considered. Then provide comparative analysis among alternatives as to whether alternatives meet the ARARs and if yes, how. Follow this approach for all alternatives in all material categories.

Response: The Group III CMS/FS will be revised as discussed in the Response to Comment 46.

Comment 59. Section 8.2.2, Page 8-6, Reduction of Toxicity, Mobility or Volume through Treatment: Only Alternatives A3 and A4 are permanent and not Alternative A2 as stated. Delete the first three sentences and replace with a statement that Alternative 1A does not include any treatment and therefore, there is no reduction of toxicity, mobility or volume. Also, the reasons for volume increase/decrease must be specified, here and in the following sections.

Response: The Group III CMS/FS will be revised accordingly with the exception that the statements regarding consolidation into Impound 8 (Alternative A2) being permanent will remain.

Comment 60. Section 8.2.2, Page 8-6, Short-term Effectiveness: Include the following in this section: Alternative A1 achieves this criterion better than any other alternatives because it can be implemented immediately. Alternative A2 is better than Alternatives A3 and A4 because it can achieve the RAOs in a shorter time frame than Alternatives A3 and A4. Follow this analysis for all material categories.

Response: The Group III CMS/FS will be revised accordingly.

Comment 61. Section 8.2.2, Page 8-6, Implementability: Delete second half of Sentence 2. Follow this for on-site incineration alternatives for all material categories.

Response: The CMS/FS will be revised to reflect this comment, however, a discussion related to community and local government opposition will be included in Section 8.2.2 as discussed in Comment 62.

Comment 62. Section 8.2.2, Page 8-7, Community Acceptance: Delete the text here and replace with the following: Community and local government are opposed to on-site incineration. Follow this for on-site incineration alternatives for all material categories.

Response: The Group III CMS/FS will be revised accordingly.

Comment 63. Section 8.2.2, Page 8-7, Cost: It must be stated in the cost comparison sections that because the impoundments were broken into groups for analysis of remedial alternatives, the costs were calculated independently and therefore may be overstated. For example, the cost of Alternative C3 (LTTT) for Impoundment 3 is approximately $10,000,000. However, approximately 40% of the cost is for mobilization of equipment. If LTTT alternatives were selected for Category A Impoundments, then the cost of Alternative C3 would be greatly reduced.

Response: This is not necessarily true. Additional mobilization costs would be incurred by factors such as equipment replacement or modification to treat materials with different chemical and physical characteristics. In addition, the handling of Category A material will likely cause a disproportionate amount of equipment maintenance (or replacement) that will be incurred upon re-mobilization to treat other material categories. Therefore, it is our assumption that at the conclusion of the Category A treatment a major retrofit of the system (e.g. refractory chamber and air handling components) will be required.

Comment 64. Section 8.3.2, Page 6-8, Reduction of Toxicity, Mobility or Volume through Treatment: Alternative B2 is not considered permanent contrary to what is stated in Sentence 4. In Sentence 6, it is stated that Alternative B4 (LTTT) would have a net material volume increase of approximately 4%. In Category A, it is stated that LTTT provides a 25% net volume increase. Please explain.

Response: As stated previously, consolidation into Impound 8 (Alternative B2) is considered permanent. The Category A material is expected to require more extensive pre-conditioning due to lower pH and higher Btu value which would result in a larger volume increase. Additionally, the pre-conditioning materials used with Category A results in a smaller volume reduction during treatment. This combination accounts for the seeming disparity in the net volume increase between the two material types. The Group III CMS/FS will be clarified.

Comment 65. Section 8.4.2, Page 8-13, Reduction of Toxicity, Mobility or Volume through Treatment: It is stated that Alternative C2 (Consolidation in Impoundment 8) includes removal of the materials as an active treatment technology. This is incorrect. Neither removal nor consolidation in Impoundment 8 is considered active treatment.

It is stated that Alternative C3 (LTTT) would result in no net volume increase. For Material Categories A and B, it is stated that LTTT would result in 25% and 4%, respectively, net volume increase. Please explain.

Response: With respect to Section 8.4.2, page 8-13, the CMS/FS will be revised to reflect the NJDEP's comment. The different volume increase associated with Categories A and B is due to the need to provide more extensive conditioning agent to Category A material, as discussed above. For Alternative C3 (LTTT), the Section 8 text will be revised to reflect an estimated 30% volume increase, consistent with Tables 8-12 and 8-15.

Comment 66. Section 8.4.2, Page 8-14, Cost: Alternative C4 is more expensive than Alternative C3.

Response: The Group III CMS/FS will be revised accordingly.

Comment 67. Section 8.5, Page 8-15, category D: As stated previously, treatment alternatives must be developed and evaluated. Also, as stated previously, delete the reference of this material as "non-hazardous fill." It is misleading.

Response: Category D has been renamed Non-hazardous Waste.

Comment 68. Section 8.5.2, Page 8-15, Overall Protection of Human Health and the Environment: Add a statement that Alternative D1 would not satisfy this criterion.

Response: The Group III CMS/FS will be revised accordingly.

Comment 69. Section 8.5.2, Page 8-16, Long-term Effectiveness and Permanence as well as Reduction of Toxicity, Mobility or Volume: Include a statement that Alternative D2 achieves these criterion better than Alternative D1.

Response: The Group III CMS/FS will be revised accordingly.

Comment 70. Section 8.5.2, Page 8-17, Cost: Revise the last sentence to read: "Alternative D2 is more expensive than Alternative D1."

Response: The Group III CMS/FS will be revised accordingly.

Comment 71. Section 9, General: NJDEP and USEPA do not concur with the recommended alternatives based on the comments specified above.

Response: No response required

Comment 72. Section 9.2, Page 9-2: Change the order of bullet items (3 to 1 and 1 to 3).

Response: The Group III CMS/FS will be revised accordingly.

Comment 73. Section 9.2, Page 9-3, Paragraph 1: Delete word "potential" from Lines 6 and 11. Group III Impoundments have been confirmed to present a continuing source of ground water contamination.

Response: The Group III CMS/FS will be revised accordingly based on the Response to Comment No. 8.

Comment 74. Section 9.3, Page 9-3, Paragraph 1: Delete the entire paragraph prior to bullet items.

Response: The Group III CMS/FS will be revised accordingly.

Comment 75. Section 9.3, Page 9-3, Bullet Item 1: It should be listed at the end of bullet items.

Response: The Group III CMS/FS will be revised accordingly.

Comment 76. Section 9.3, Page 9-3, Bullet Item 2: Based on the treatability data, bioremediation would not remove the compounds of concern as efficiently (it does not reduce contaminants concentration as low as thermal) as the thermal treatment options for material category B.

Response: The Group III CMS/FS will be revised to state that bioremediation removes the compounds of concern as *effectively* as LTTT in achieving remedial action objectives. Additionally, the use of LTTT for Material Category B will most likely be less efficient than LTTT of Material Category A. Higher levels of SVOC compounds exist in the Category B materials which may not be removed by thermal treatment as well as the removal of lower concentrations of SVOCs which were in Category A treatability testing. Furthermore, the characteristics of the tar materials in Category B (for example, stringy and tacky tars in Impoundment 5) may present more difficult material handling and less efficient treatment.

Comment 77. Section 9.4, Pages 9-4 and 9-5: Delete the entire sections 9.4.1 through 9.4.4. They are redundant.

Response: The Group III CMS/FS will be revised accordingly.

Comment 78. Section 9.4.2, Page 9-4, Long-term Effectiveness: Provide explanation for the phrase "landfill-like" materials.

Response:	AHPC agrees with the NJDEP's comment; however, comment 77 deletes this section from the CMS/FS therefore no explanation within the CMS/FS will be required.
Comment 79.	Table 7-1: See previous comments about ARARs.
Response:	The Group III CMS/FS tables will be modified to reflect the previous comments.
Comment 80.	Attachment 1 to Exhibit G, Volume 1, Page G1-1, Toxicity: Part of Impoundment 8 Facility has already been constructed. Ground water in the vicinity of the Impoundment 8 Facility is not contained by a pump and treat system. It is contained by an intercepter trench.
Response:	The evaluations were revisited using the agency recommendations and the conclusions regarding risk reduction did not change. The Group III CMS/FS will be revised accordingly.
Comment 81.	Attachment 1 to Exhibit G, Volume 1, Page G1-2, Concentration: If a chemical was detected in a given impoundment, half of detection limit for that chemical should be used in accordance with the USEPA's Superfund Risk Assessment Guidance.
Response:	The Group III CMS/FS will be revised accordingly.
Comment 82.	Volume 2, Appendix A, Section 2.6.1, Page 2-52, Last Paragraph: Describe the other effective means of decontamination.
Response:	The other means of decontamination of the equipment during the pilot tests involved material segregation from the equipment prior to steam cleaning. The Group II CMS will be revised accordingly.
Comment 83.	Volume 2, Appendix A, Section 5.2.5, Page 5-5, Last Paragraph: The rate of water addition required to optimize material strength must be determined during remedial design.
Response:	This issue will be evaluated during the remedial design phase.
Comment 84.	Volume 2, Appendix A, Section 5.2.5, Page 5-6, First Paragraph: Additional bench-scale studies recommended in this section to identify appropriate admixtures and addition rates needed to increase the unconfined compressive strength required for disposal in Impoundment 8 Facility must be carried out during remedial design. If strength criteria cannot be met, the treated material may have to be disposed off-site.
Response:	Additional testing will be conducted to identify the appropriate admixtures necessary to meet the compressive strength requirements.
Comment 85.	Volume 2, Appendix A, Section 5.2.6, Page 5-6: As specified, the quantity and type of residuals must be evaluated for disposition during remedial design. If appropriate means of on-site disposal is not available, off-site disposal may be required.

Response: Options for residuals management will be evaluated during remedial design.

Comment 86. Volume 2, Appendix A, Section 5.2.7, Page 5-6: As recommended in this section, the issue of heavy organics condensation in the vent lines must be addressed during remedial design.

Response: This issue will be evaluated during the remedial design phase.

Comment 87. Volume 2, Appendix A, Section 5.2.8, Page 5-7, Paragraph 1: Unless prior approval is obtained from the SRVSA, this option of discharging the treated water to the Publicly Owned Treatment Works (POTW) cannot be considered.

Response: As discussed in Comment 5 , American Cyanamid currently has an agreement with SRVSA to discharge wastewaters including those generated during remediation.. Specific requirements regarding this discharge of remedial wastewaters will be addressed in the remedial design phase of this program.

Comment 88. Volume 3, Appendix B, Section 3.1, Page 3-3, Paragraph 2: Provides descriptions of excavation for Impoundment 14. Also, both Figures 3-14 and 3-15 reference Impoundment 14. This is incorrect. Please revise.

Response: The Group III CMS/FS will be revised accordingly.

Comment 89. Volume 3, Appendix B, Section 3.2, Page 3-9, Paragraph 1: Optimization of sawdust amendment must be evaluated during remedial design.

Response: This will be evaluated during remedial design; however, optimization will also occur during full-scale operation.

Conference Call
Comment: The use of the NJDEP soil sampling guidance (5 times with a ceiling of 200 ppm) does not appear appropriate for compliance sampling.

Response: The NJDEP allows the use of sample result averaging to determine compliance with soil cleanup criteria. Averaging is allowed to account for the inherent variability present within a heterogenous matrix such as soil. This heterogeneity is also present within the impoundment contents proposed to undergo treatment. Since compliance averaging is deemed suitable for an area of heterogenous soil it would also be appropriate for monitoring a volume of heterogenous, treated sludge. For this reason the five times multiplication factor with a ceiling of 200 ppm was selected to adjust the treatment objective to account for the variability in collection of representative samples.

Conference Call
Comment: Provide a better description and give an example as to how the treatment objectives were calculated.

Response: Based on the agency comments the treatment objectives were recalculated and are presented in Attachment 4 with a description of the method and a sample calculation.

Upon completion of your review and receipt of agency concurrence, a schedule for revising the Group III CMS/FS in accordance with these responses will be developed. Should you have any questions or comments, please feel free to call me.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Angelo J. Caracciolo, III
Project Associate

AJC:ndl
5772.010.627\ltr.102

cc: Mr. James Hacklar, United States Environmental Protection Agency
Ms. Patricia W. McDonald, American Home Products Corporation
Mr. Thomas M. Donohue, American Home Products Corporation
Mr. Steven J. Roland, O'Brien & Gere Engineers, Inc.

cc: SJR
AJC
GAA
PLS
STP

FILE: 5772.010#11

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

NOV 25 1996

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
NO. P519590133

Patricia Wells McDonald, Manager-Environmental Affairs
American Home Products Corporation
Department of Environment & Safety
1 Campus Drive
Parsippany, NJ 07054

Dear Ms. McDonald:

Re: American Home Products Corporation/American Cyanamid Company Site
Bridgewater Township, Somerset County

The New Jersey Department of Environmental Protection (NJDEP) and the United States Environmental Protection Agency (USEPA) have reviewed a letter from O'Brien & Gere dated September 13, 1996 (received on September 16, 1996) responding to our comments for the Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS) Report dated April 1996. NJDEP and USEPA comments are as follows:

GENERAL COMMENT:

Note: This comment and several other related specific comments (which are specified later in this document) were developed by USEPA.

1. Attachment 4 of the response document proposes the following treatment objectives for both low temperature thermal treatment (LTTT) and biotreatment:

COMPOUNDS	LTTT Max. Value mg/kg	LTTT Percent Reduction	BIOTREATMENT Max. Value mg/kg	BIOTREATMENT Percent Reduction
Benzene**	85	99.9	60	99.7
Toluene	200	98.8	145	95.3
Xylene	115	96.7	230	95.8
Naphthalene	670	93.9	13,100	94.5
Nitrobenzene	165	87.6	5,200	38.8

1,2-dichloro-benzene	200	96.7	320	78.7
N-Nitroso-diphenylamine	5	96.7	14,300	31.9
2-Methyl-naphthalene	200	86.8	1,900	79.3

Biotreatment objectives of 13,100 mg/kg, 5,200 mg/kg and 14,300 mg/kg respectively for naphthalene, nitrobenzene and N-Nitrosodiphenylamine are extremely high and would result in material with these concentration being placed into the Impoundment 8 Facility.

Biotreatment with placement into the Impoundment 8 Facility does not afford sufficient long-term or permanent reductions in toxicity, mobility and volume of the contaminants of concern. There will always be a potential for Impoundment 8 to fail, which could result in the release of high levels of contaminants into the environment. While studies focusing on other treatment methods for this material have not been performed, it would seem that LTTT has the potential for ensuring a higher percent reduction than biotreatment. On page 8-10 of the CMS/FS, it is stated that both biotreatment and LTTT are implementable. Additionally, the cost information provided on page 8-11 of that document indicates that a change from biotreatment to LTTT would result in a cost increase of only 24% (from $33,000,000 to $41,000,000).

Based on the above, the proposed biotreatment objectives do not ensure adequate long-term protection of human health and the environment. Therefore, it is recommended that the proposed biotreatment alternative be re-evaluated, either through modification of the biotreatment process or another treatment process (such as LTTT), in order to establish more stringent treatment objectives.

SPECIFIC COMMENTS:

1. Response 5: Explanation provided in this response must be incorporated in to the revised CMS/FS report.

2. Response 7: New Jersey Public Law P.L. 1993, c. 139 (NJSA 58:10B) established an acceptable cancer risk level of 1×10^{-6}. This risk level is more stringent than USEPA's acceptable risk range of 1×10^{-4} and 1×10^{-6}. The risk levels of 2.4×10^{-6} is above the acceptable risk level established in New Jersey. As such, our comment is still valid.

3. Response 8: Based on the on-going ground water monitoring data and Impoundment Characterization Results, it has been proven that the contaminated material of the Group III Impoundments is a continuous source of ground water contamination. As such, our comment is still valid.

4. Response 9: In addition to regulatory concern, metals are considered a concern with respect to treatment. Post-treatment material must meet the levels established under Toxicity Characteristics Leaching Procedure (TCLP) and the strength criteria of 15 psi prior to consolidation into the Impoundment 8 Facility. If post-treatment material does not meet these levels and criteria, then solidification treatment must be performed. Because of this, metals are considered a concern with respect to secondary treatment.

5. Response 19: The clarification provided for the third sentence must be included in the revised CMS/FS. The third sentence must be revised as follows: "Treatment would enhance the risk through a reduction in contaminant levels".

6. Response 22: **See # 4** for the first sentence. Information provided in this response (concerning treatment objectives for metals) must be incorporated in the CMS/FS report. Treatment objective for metals must be non-leachability as measured by TCLP and 15 psi strength criteria. Compliance with this objective (to be established during the remedial design) must be based on post-treatment analytical data.

7. Response 23: As previously indicated, USEPA requires that the CMS/FS should be developed exclusive of the Corrective Action Management Unit (CAMU) issue. Therefore, the language proposed here for incorporation into the CMS/FS is inappropriate and should not be used.

8. Response 26: Average compliance must be based on monthly monitoring.

9. Responses 26 and 27: Based on the General Comment, USEPA does not accept these responses.

10. Response 28: Information provided in this response must be incorporated in the CMS/FS.

11. Response 30: Not acceptable to USEPA. **See # 7.**

12. Response 31, 33 and 37: Not acceptable to USEPA. See General Comment.

13. Response 38: TCLP leachability evaluation must be based on post-treatment data.

14. Response 44: Attachment 7 does not include comparative analysis among remedial alternatives being considered. It must be included in the revised CMS/FS. Until we evaluate this comparative analysis, your recommendation for consolidation into the Impoundment 8 facility for Material Category D is not acceptable.

15. Response 58: Response is provided for only the first sentence of our comment. Response must be provided for the rest of the comment.

16. Response 59: NJDEP still does not agree with your determination that Alternative A2 (Consolidation into Impoundment 8 Facility) is permanent. This alternative does not remove or destroy contaminants. It only provides containment of the contaminants and requires long-term management.

17. Response 64: **See # 16.**

18. Response 67: As stated in Response to Comment 44, Category D should be Non-hazardous Materials (not waste as mentioned here).

19. Response 73: **See # 3.**

20. Response 76: USEPA does not believe that biotreatment will be as effective in the long-term as LTTT in meeting the remedial action objectives. As such, proposed revision to the CMS/FS text (indicating that bioremediation removes the compounds of concern as effectively as LTTT in achieving remedial action objective) is not acceptable to USEPA.

21. Response 87: Description of excavation for Impoundment 14 still needs to be provided.

Please submit the revised CMS/FS Report incorporating the above comments within 30 calendar days after receipt of this letter.

If you have any questions, please contact me at (609) 633-0718.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Jim Hacklar, USEPA-SUPERFUND

cc: AJC
SJR
GAA
File: 5772.013
TASK 6 # 2

AMERICAN HOME PRODUCTS CORPORATION

ONE CAMPUS DRIVE, PARSIPPANY, NEW JERSEY 07054 (201) 683-2000

January 30, 1997

ENVIRONMENT & SAFETY

RECEIVED
FEB 4 1997
O'B & G
EDISON

Mr. Haiyesh Shah
Case Manager
NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Federal Case Management
Division of Responsible Party Site Remediation
401 East State Street, 5th Floor West
CN 028
Trenton, New Jersey 08625-0028

Dear Mr. Shah:

Re: Group III Impoundments CMS/FS Report
Response to 11/25/96 Comments
Bound Brook, New Jersey Facility
American Cyanamid Company

This letter provides American Home Products Corporation's (AHPC) responses to the second set of agency comments on the Group III Corrective Measures Study/Feasibility Study (CMS/FS) Report (O'Brien & Gere, April 1996) for the American Cyanamid Site in Bound Brook, New Jersey. An initial comment letter from the agencies was issued on July 15, 1996. Responses to these comments were provided in O'Brien & Gere's letter dated September 13, 1996. Subsequent comments were received in your letter dated November 25, 1996, and were further clarified in conference calls on December 12, 1996 and January 6, 1997.

The following is a summary of the individual agency comments and AHPC responses. Upon your review of these responses, we feel it would be beneficial to schedule a meeting with the agencies to discuss the issues and establish resolution.

GENERAL COMMENT

Note: This comment and several other related specific comments (which are specified later in this document) were developed by USEPA.

Comment 1: Attachment 4 of the response document proposes the following treatment objectives for both low temperature thermal treatment (LTTT) and biotreatment:

Compounds	LTTT Max. Value (mg/kg)	LTTT Percent Reduction	Biotreatment Max. Value (mg/kg)	Biotreatment Percent Reduction
Benzene	85	99.9	60	99.7
Toluene	200	98.8	145	95.3
Xylene	115	96.7	230	95.8
Naphthalene	670	93.9	13,100	94.5
Nitrobenzene	165	87.6	5,200	38.8
1,2-dichlorobenzene	200	96.7	320	78.7
N-Nitrosodiphenylamine	5	96.7	14,300	31.9
2-Methylnaphthalene	200	86.8	1,900	79.3

Biotreatment objectives of 13,100 mg/kg, 5,200 mg/kg and 14,300 mg/kg respectively for naphthalene, nitrobenzene and N-Nitrosodiphenylamine are extremely high and would result in material with these concentrations being placed into the Impoundment 8 facility.

Biotreatment with placement into the Impoundment 8 facility does not afford sufficient long-term or permanent reductions in toxicity, mobility, and volume of the contaminants of concern. There will always be a potential for Impoundment 8 to fail, which could result in the release of high levels of contaminants into the environment. While studies focusing on other treatment methods for this material have not been performed, it would seem that LTTT has the potential for ensuring a higher percent reduction than biotreatment. On page 8-10 of the CMS/FS, it is stated that both biotreatment and LTTT are implementable. Additionally, the cost information provided on page 8-11 of that document indicates that a change from biotreatment to LTTT would result in a cost increase of only 24% (from $33,000,000 to $41,000,000).

Based on the above, the proposed biotreatment objectives do not ensure adequate long-term protection of human health and the environment. Therefore, it is recommended that the proposed biotreatment alternative be re-evaluated either through modification of the biotreatment process or another treatment process (such as LTTT), in order to establish more stringent treatment objectives.

Response: **The USEPA has commented on several issues pertaining to the acceptability of the biotreatment objectives. The following responses address issues raised in the above comment:**

- **Throughout the comment, USEPA makes several statements that the biotreatment levels are not stringent enough based on the proposed treatment levels being "extremely high," or not affording "sufficient" long-term or permanent reductions or "adequate" long-term protection. The agency has focused on the absolute concentrations resulting from biotreatment and comparison to the absolute level potentially achievable by LTTT. The agency appears to have ignored relative risk, even though an evaluation of risk is clearly identified in the National Contingency Plan (NCP) as a component of the detailed analysis of remedial alternatives.**

  Absolute numerical concentrations of hazardous substances following treatment are used primarily in LDRs. USEPA has acknowledged that the LDRs may be overly protective in a remediation context, and that their chief benefit is the strong incentive created for waste minimization at the point of generation and the resulting internalization of waste disposal and treatment costs in production operations [59 Fed. Reg. 47982 (Sept. 19, 1994)]. Because LDR concentrations are not applicable to site remediation, especially given the heterogeneity of wastes often found in impoundments and other pre-RCRA disposal units, USEPA has recognized that meaningful protection can be provided through some level of treatment that reduces the volume, toxicity or mobility of the hazardous substances without resorting to inflexible UTS levels. When LDRs are legally inapplicable, no regulation, policy or guidance would compel an absolute level of post-treatment residuals independent of risk considerations. While, the degree of treatment as measured by percentage reduction is a measure of the degree to which the statutory preference for "treatment which permanently and significantly reduces the volume, toxicity or mobility of hazardous substances" has been achieved, [CERCLA 121(b)], absolute reduction in the volume, toxicity or mobility of treatment residue should not be the sole or even the predominant consideration.

  Once a proposed remediation alternative meets USEPA's two threshold criteria (ARAR compliance and protection of human health and the environment), the USEPA is required to balance five other factors (long term effectiveness and permanence; toxicity, mobility or volume reduction through treatment (TMV reduction); short-term effectiveness; implementability; and cost). USEPA's general comment recites some of those balancing factors, but appears to elevate TMV reduction to a threshold criteria without regard to cost, effectiveness or implementability. We do not agree with USEPA's comment that biotreatment with placement into Impound 8 "does not afford sufficient long-term or permanent reduction in toxicity, mobility and volume

of the contaminants of concern." The comment makes no attempt to define or elaborate on what is a "sufficient" level of treatment. Mobility and volume reduction criteria are equal for the two alternatives. For the toxicity component, the treated residual levels should be viewed (and measured) in relation to the risk posed by the remaining levels of hazardous substances as they are proposed to be managed, not the absolute levels achievable by different technologies.

A relative risk analysis was presented in the April 1996 CMS/FS, and concluded that a 99% reduction in the benzene mass alone (as demonstrated in biotreatment) results in an overall risk reduction of 93%. In the September 13, 1996 response submittal, a risk reduction comparison was performed for compound of concern treatment levels proposed for biotreatment and LTTT. The results indicated only a 0.5 % difference in relative risk reduction when comparing the two technologies. More importantly, the biotreatment objective proposed for benzene (the compound which represents the greatest risk) is acceptable to USEPA and the other contaminants pose a lower order of risk at the biotreatment levels.

Based on the above, AHPC requests that USEPA reconsiders its comment and approves the proposed treatment objectives. AHPC believes that the proposed biotreatment levels for naphthalene, nitrobenzene and n-nitrosodiphenylamine are acceptable from a risk reduction perspective. In fact, they are virtually indistinguishable from the unproven LTTT values preferred by USEPA.

- USEPA's statement regarding the "possibility" that Impound 8's failure "could" result in "high" levels of contaminants being released in the environment is disingenuous in light of the Minimal Technical Requirements (MTRs) that the agency has established to minimize such an occurrence. For example, within the preamble to the proposed rule (Hazardous Waste Management System; Proposed Codification of Statutory Provisions, 51 Fed. Reg. 10708, Mar. 28, 1986), it states that "the Agency assumes that these units will contain hazardous constituents that will be capable of migrating out of the units. The goal of the liners and leachate collection systems is to prevent migration by collecting and removing leachate before it can migrate during the unit's active life and post-closure care period...we believe that this design is effective in protecting human health and the environment because the combination of the two components in the bottom liner system provides for virtually complete removal of waste or leachate by the leachate collection system if a leak were to occur in the top liner."

The design of Impound 8 not only meets but exceeds the MTRs through the following components:

- installation of double (primary and secondary) composite liner system with leachate detection, collection, and treatment which exceeds the 40 CFR 264.301 requirement of only a composite system on the secondary liner;

- use of 60-80 mil HDPE material, which exceeds USEPA's MTR guidance thickness of 30 mil;

- use of geosynthetic clay which exhibits a minimum hydraulic conductivity of 1×10^{-9} cm/s, which exceeds the MTR requirement of 1×10^{-7} cm/s; and,

- groundwater interception trench and monitoring system, which maintains a continued separation between the bottom of the impoundment and ground water. This is not even addressed in MTR guidance.

Further, the liner material has already been evaluated by the manufacturer with respect to comparable (or higher) constituent concentrations than those proposed by the biotreatment objectives. The evaluation concludes that the Group III material, as treated to the biotreatment levels, will be compatible with the liner material.

Because of these reasons, Impound 8 ensures a more reliable protection of human health and the environment (a key component of USEPA's Long-Term Effectiveness and Permanence threshold criteria) than existing USEPA standards.

- USEPA contends that using LTTT will result in cost increase of *only* 24%, which represents $8 million based on the magnitude of this project. In accordance with 40 CFR S300.430 (f)(1)(ii)(D), USEPA states that a remedial alternative is not cost effective unless its "costs are proportional to its overall effectiveness." Overall effectiveness is determined by evaluating short term effectiveness; long term effectiveness and permanence; and reduction in toxicity, mobility and volume. Based on an evaluation of these USEPA criteria, biotreatment and LTTT are comparable in overall effectiveness. In comparing the two treatment technologies and resultant treatment objectives, there is no appreciable difference in short-term effectiveness. Similarly, the impacts on the community, workers, and the environment are comparable for LTTT versus biotreatment. While the time associated with biotreatment is slightly longer, that difference is insignificant. Further, based on a relative risk reduction difference of only 0.5% for the two technologies and the state-of-the-art design of the Impound 8 facility, there is no appreciable difference in long-term effectiveness and permanence of either remedy.

The sole area of distinction appears to be the degree of reduction in toxicity through treatment when comparing LTTT versus biotreatment. As stated above, reduction in mobility is achieved for both remedies by materials removal from the original impoundments, solidification, and placement into Impound 8. Although there is a volume increase associated with biotreatment, it is not a volume increase in contaminants. Rather, the contaminants are permanently destroyed through biological degradation using naturally-occurring inert materials (ie. saw dust) to enhance the process. Last, the net difference in reduction in toxicity is calculated at 0.5%, based on risk reduction factors.

- **It is inappropriate to compare Impoundments 1 and 2 LTTT results and Impoundments 4, 5, 14, 20 and 26 biotreatment results in the same table. While USEPA acknowledges that LTTT testing was not performed for the material planned for biotreatment, the side-by-side comparison of the two technologies is misleading because the table incorrectly implies that LTTT outperforms biotreatment; LTTT may not necessarily remove the semi-volatiles (which are present in higher concentrations in the biotreatment impoundments) to the same levels as observed in the Impoundments 1 and 2 LTTT testing. In fact, the opposite may be true in some instances. For example for naphthalene, the percent removal that is achievable using biotreatment is greater than that observed using LTTT, again demonstrating that LTTT would not necessarily provide a greater level of treatment. The following table provides the comparison in untreated (feed) concentrations for compounds of concern within materials planned for the two treatment technologies.**

Compound	LTTT Feed (Imp. 1, 2, 3) Max. Value (mg/kg)	Bio Feed (Imp. 4, 5, 14, 20, 26) Max. Value (mg/kg)
Benzene	61,000	21,000
Toluene	16,200	3,100
Xylenes	3,440	5,500
Naphthalene	*11,000*	*240,000*
Nitrobenzene	*1,330*	*8,500*
1,2-dichlorobenzene	6,100	1,500
N-Nitrosodiphenylamine	*150*	*21,000*
2-Methylnaphthalene	1,520	9,200

As can be seen, the feed concentrations for a majority of the semi-volatiles, especially naphthalene, nitrobenzene, and n-nitrosodiphenylamine, are orders of magnitude higher for the material planned for biotreatment than for the LTTT feed. The materials planned for biotreatment clearly exhibit different characteristics, especially for compounds that would be expected to be more difficult to remove in a thermal system due to lower volatility.

In summary, AHPC is not in agreement with the USEPA's rationale regarding the need to lower the proposed biotreatment objectives for naphthalene, nitrobenzene, and n-nitrosodiphenylamine. Extrapolation of LTTT testing data shows that the naphthalene levels may be lower after biotreatment than after LTTT. USEPA does not assert that LTTT will provide $8 million worth of net benefits to the public, moreover, the data demonstrate that any incremental protection afforded by additional treatment is negligible at best, is statistically insignificant, and unnecessarily costly.

SPECIFIC COMMENTS

Comment 1: Response 5: Explanation provided in this response must be incorporated into the revised CMS/FS report.

Response: **Agree. The explanation concerning the type of ground water treatment and SRVSA permit will be incorporated into the revised CMS/FS.**

Comment 2: Response 7: New Jersey Public Law P.L. 1993, c 139 (NJSA 58:10B) established an acceptable cancer risk level of $1x10^{-6}$. This risk level is more stringent that USEPA's acceptable risk range of $1x10^{-4}$ and $1x10^{-6}$. The risk levels of $2.4x10^{-6}$ is above the acceptable risk level established in New Jersey. As such, our comment is still valid.

Response: **This statutory section must be read in context. It is entitled "Minimum remediation standards, Recommendations of the Environmental Advisory Task Force," and was enacted to redirect NJDEP's reliance on USEPA's unnecessarily conservative approach to environmental remediation standards. Thus, for example, the same section directs NJDEP to base its remediation standards on "reasonable assumptions of exposure scenarios," and to "avoid the use of redundant conservative assumptions" by "the use of parameters that provide an adequate margin of safety and which avoid the use of unrealistic conservative exposure parameters." The 2.4 x 10^{-6} cited from the Baseline Endangerment Assessment is premised on multiple conservative assumptions built into the USEPA methodology, which the New Jersey legislature has indicated should not control. We are confident that if reasonable assumptions were applied consistent with the statutory language, the risk would be less than $1x10^{-6}$.**

Comment 3: Response 8: Based on the ongoing ground water monitoring data and Impoundment Characterization Results, it has been proven that the contaminated material of the Group III Impoundments is a "continuous" source of ground water contamination. As such, our comment is still valid.

Response: **AHPC still does not agree that the Group III material is a continuous source of ground water contamination. However, in order to resolve this issue, AHPC will comply with NJDEP's request and revise this statement accordingly.**

Comment 4: Response 9: In addition to regulatory concern, metals are considered a concern with respect to treatment. Post-treatment material must meet the levels established under Toxicity Characteristics Leaching Procedures (TCLP) and the strength criteria of 15 psi prior to consolidation into the Impoundment 8 facility. If post-treatment material does not meet these levels and criteria, then solidification treatment must be performed. Because of this, metals are considered a concern with respect to secondary treatment.

Response: **Some of the impoundment material already passes TCLP (without treatment). Therefore, flexibility should be provided within the CMS/FS to allow for the demonstration of TCLP compliance prior to treatment. Post-treatment will be conducted to achieve strength criteria, and if necessary, to meet TCLP levels in the event that pre-treatment material does not pass this criteria. The remedial design will address this issue in greater detail.**

Comment 5: Response 19: The clarification provided for the third sentence must be included in the revised CMS/FS. The third sentence must be revised as follows: "Treatment would enhance the risk through a reduction in contaminant levels".

Response: **AHPC agrees with the concept behind this statement, but sees the potential for misinterpretation by a reader because of the phrase "...enhance the risk..." Therefore, the following alternative sentence is proposed for inclusion in the revised CMS/FS.**

"Treatment would lower the risk through a reduction in contaminant levels".

Comment 6: Response 22: See #4 for the first sentence. Information provided in this response (concerning treatment objectives for metals) must be incorporated in the CMS/FS report. Treatment objective for metals must be non-leachability as measured by TCLP and 15 psi strength criteria. Compliance with this objective (to be established during the remedial design) must be based on post-treatment analytical data.

Response: **See Response No. 4.**

Comment 7: Response 23: As previously indicated, USEPA requires that the CMS/FS should be developed exclusive of the Corrective Action Management Unit (CAMU) issue. Therefore, the language proposed here for incorporation into the CMS/FS is inappropriate and should not be used.

Response: **AHPC has difficulty in understanding the purpose for USEPA insisting that alternatives be developed exclusive of the pending CAMU petition. The CAMU is an essential part of this CMS/FS. If USEPA is requiring that RCRA's Land Disposal Restrictions ("LDRs") be included as applicable, relevant, and appropriate requirements ("ARARs") in the alternative analysis - which is a consequence of ignoring the CAMU - then incineration is probably the only remedy that is ARAR compliant independent of a CAMU. Because ARAR compliance is a threshold criteria, the CMS/FS therefore would never discuss the balancing criteria (long-term effectiveness and permanence; toxicity, mobility or volume reduction through treatment; short-term effectiveness; implementability; and cost) with regard to either biotreatment or LTTT. The pilot work on LTTT and biotreatment was authorized specifically with full knowledge that neither was likely to achieve LDRs but would be ARARs compliant if treatment residuals were contained within a CAMU. USEPA has indicated that it is willing to accept treatment objectives above LDR levels. Finally, the community has already expressed itself on the unacceptability of incineration at the site. Rather than attempting to de-couple the pending CAMU petition from the CMS/FS analysis, the two should be developed jointly to ensure a realistic discussion of implementable remedies and to maximize USEPA's ability to achieve a viable and acceptable remediation strategy for the site. USEPA should view the CAMU as an integral part of the solution because of the additional discretion it provides to achieve a remedy that will be acceptable to all relevant stakeholders, including community members who are opposed to incineration.**

Such practical considerations recently were taken into account by the USEPA in a similar context. In its recent final decision granting a treatability variance to Citgo for remediation of surge pond sludges in Lake Charles, Louisiana, the USEPA approved treatment levels above LDR levels for 10 of 17 hazardous constituents, and thus avoided an incineration remedy (See 61 Fed. Reg. 55718, October 28, 1996). The Agency cited various "net environmental benefits" associated with its decision, including avoidance of a protracted dispute and lengthy litigation with Citgo about incineration, to support its decision in favor of prompt remediation. Id at 55724. In that case, although the treatment residue did not meet LDR standards, its placement into a state-of-the-art hazardous waste landfill was cited as an additional protection. The USEPA also examined the potential adverse environmental impacts associated with transportation of hazardous waste for off-site incineration. The USEPA's flexible recognition that less stringent treatment options can protect the public and result in a "net environmental benefit," especially when such waste is place in a RCRA-compliant landfill, is equally applicable to the Bound Brook site.

To retain maximum flexibility, the USEPA should assume, albeit conditionally, that the CAMU petition will be granted, instead of seeking to "decouple" it from the CMS/FS process. As a matter of law, placement of treated residual in a CAMU would be ARAR compliant, would satisfy CERCLA's statutory preference for treatment, and would avoid a presumption in favor of incineration. Indeed, the CAMU regulatory preamble acknowledges that "the Agency may consider containment to be sufficiently effective" in a particular case, 58 Fed. Reg. At 8670, and that in USEPA's view, the 1984 HSWA amendments were "not intended to preclude remedial alternatives that did not employ treatment, so long as such options could ensure long-term effectiveness of the remedy." Admittedly, USEPA continues to have a "strong preference" for treatment Id. at 659-60, but where a CAMU is proposed, the ARAR level is no longer the UTSs. The CAMU regulations do not mandate a particular level of treatment and do not require compliance with LDRs.

Comment 8: Response 26: Average compliance must be based on monthly monitoring.

Response: **AHPC prefers to establish the monitoring frequency as part of the remedial design phase of the program. The remedial design phase will address raw material characterization, construction sequencing, volume throughput and placement of the treated material into Impound 8. The frequency of compliance monitoring may be different based on the parameter being monitored and may not necessarily be time-dependent. For example, compressive strength monitoring may be performed on a volume or area basis. Metals monitoring would be dependent on raw material characteristics, pursuant to Comment Response #4 above. Finally, organic constituent monitoring may be a combination of analytical testing and operations monitoring. Because these components are as of yet undefined, we believe it is premature to identify and commit to a monitoring schedule at this time.**

Comment 9: Responses 26 and 27: Based on the General Comment, USEPA does not accept these responses.

Response: **See General Comment Response No. 1.**

Comment 10: Response 28: Information provided in this response must be incorporated in the CMS/FS.

Response: **The response information provided for original Comment No. 28 will be incorporated into the revised CMS/FS.**

Comment 11: Response 30: Not acceptable to USEPA. See # 7.

Response: **Please refer to Response No. 7.**

Comment 12: Response 31, 33 and 37: Not acceptable to USEPA, See General Comment.

Response: **Please refer to General Comment Response No. 1.**

Comment 13: Response 39: TCLP leachability evaluation must be based on post-treatment data.

Response: **Please refer to Response No. 4.**

Comment 14: Response 44: Attachment 7 does not include comparative analysis among remedial alternatives being considered. If must be included in the revised CMS/FS. Until we evaluate this comparative analysis, your recommendation for consideration into the Impoundment 8 facility for Material Category D is not acceptable.

Response: **Based on our telephone conversation of December 12, 1996, it was agreed that the intent of evaluation was acceptable, but the comparative analysis needs to be reviewed by the agencies. The text is provided as Attachment 1 and will also be incorporated within the revised CMS/FS.**

Comment 15: Response 58: Response is provided for only the first sentence of our comment. Response must be provided for the rest of the comment.

Response: **Pursuant to our conference call with you on January 6, 1997, it was agreed that the ARAR comparative analysis in Section 8 of the CMS/FS would be revised to clarify the identification of ARARs and how they would be met in a comparative format for the alternatives presented under each material category. An example of the revised ARAR comparative analysis has been provided for material category A and is presented in Attachment 2 to this letter.**

Comment 16: Response 59: NJDEP still does not agree with your determination that Alternative A2 (Consolidation into Impoundment 8 Facility) is permanent. This alternative does not remove or destroy contaminants. It only provides containment of the contaminants and required long-term management.

Response: **Agree with variation. The term "permanence" will be clarified with respect to the degree of permanence relative to other alternatives since Impound 8, by design, will provide long-term containment and management of contaminants. The suggested revision to Section 8.2.2 on Page 8-6 is as follows:**

Alternative A1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternative A2 (consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in Impound 8. A slight volume increase (approximately 10%) is expected due the addition of conditioning admixtures. Alternative A3 (LTTT) offers a greater reduction in toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. A net volume increase of 25% is expected due to pre-LTTT conditioning and post-LTTT conditioning with admixtures. Alternative A4 offers the greatest reduction in toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative A1 is not considered permanent as no treatment would take place. Alternative A2 would provide for permanence through irreversible solidification conditioning and placement in Impound 8, a state-of-the-art triple lined waste management facility. Alternative A3 and A4 are considered permanent due to irreversible treatment and placement within the Impound 8.

Comment 17: Response 64: See #16.

Response: **Please refer to Response No. 16.**

Comment 18: Response 67: As stated in Response to Comment 44, Category D should be Non-Hazardous Materials (not waste as mentioned here).

Response: **This will be changed in the revised CMS/FS.**

Comment 19: Response 73: See #3.

Response: **Please refer to Response No. 3.**

Comment 20: Response 76: USEPA does not believe that biotreatment will be as effective in the long-term as LTTT in meeting the remedial action objectives. A such, proposed revision to the CMS/FS text (indicating that bioremediation removes the compounds of concern as effectively as LTTT in achieving remedial action objective) is not acceptable to USEPA.

Response: **Please refer to General Comment Response No. 1.**

Comment 21: Response 87: Description of excavation for Impoundment 14 still needs to be provided.

Response: **Clarification of this comment was provided during the conference call with you on January 6, 1997. It is our understanding that there was a typographical error and the Response 87 should be Response 88, which discusses the Impoundment 14 excavation. The proposed revision to the 2nd paragraph on Page 33 of Appendix B is as follows:**

> **Impoundment 5 excavation access is illustrated in Figure 3-13. Material collected from this location represented soft tar and sludge as anticipated based on cross-sectional data. Figure 3-14 indicates the stringy black tar collected from Impoundment 14. Figure 3-15 illustrates the excavation access for Impoundment 14.**

AHPC trusts that the responses provided in this letter clarify our position regarding the Group III CMS/FS and the recommended treatment objectives. In order to bring these issues to resolution, we strongly recommend that a meeting be scheduled with NJDEP, USEPA and AHPC upon the agencies' review of this letter. Should you have any questions, please call me or Tom Donohue at your convenience.

Sincerely,

Thomas Donohue for

Patricia W. McDonald
Manager
Environmental Affairs

PWM:cc
l:\donohue\dcmsltr.02

cc: J. Hacklar, USEPA
H. Hintz, AHPC
M. Tribble, AHPC
A. Caracciolo, OBG

ATTACHMENT 1

8.5 Category D: Non-Hazardous Material

8.5.1 Individual analysis of alternatives

The remedial alternatives which are being evaluated for the non-hazardous fill include:

- Alternative D1 - no action/institutional controls
- Alternative D2 - bioremediation with final placement in Impound 8
- Alternative D3 - off-site disposal
- Alternative D4 - consolidation in Impound 8

The individual analysis of alternatives for Category D: Non-hazardous material with respect to the nine evaluation criteria is documented in Table 8-xx. Detailed cost estimates for each of the above alternatives is provided in Tables 8-xx - 8-xx. For Alternatives D2 and D4, O&M costs associated with the Impound 8 facility were not included in the alternative cost estimates.

8.5.2 Comparative analysis of alternatives

Overall protection of human health and the environment. Existing site controls, such as locking gates and a manned guardpost, and land use restrictions, would slightly increase the level of protection from human exposure to the non-hazardous material constituents by limiting access to the impoundments. However, the potential for material constituent migration would remain. Alternative D2 would minimize human exposure to the material constituents and minimize migration to environmental media through removal, bioremediation and containment of the material in Impound 8. Alternatives D3 and D4 would also minimize human exposure and migration to environmental media through removal and containment of the material at either an off-site disposal facility or on-site at Impound 8.

Compliance with ARARs. As described in Section 7, no chemical-specific ARARs were identified for the 4 alternatives. No location-specific ARARs have been identified for Alternative D1. Alternative D1, D2, and D3 would be subject to New Jersey Flood Hazard Control Act Regulations (NJAC 7:13-1 et. seq.) This ARAR would be met by having on-site work conducted in floodplain areas consistent with substantive permit requirements.

Action-specific ARARs identified for Alternative D1 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARs would be met by specifying and monitoring activities so that they are conducted in accordance with the ACO, NJAC 7:26E et. seq. and OSHA. These requirements, as well as New Jersey SESC requirements; DOT transport requirements; and New Jersey air control regulations, are potentially applicable action-specific ARARs for Alternatives D2, D3 and D4. These ARARs, as applicable, would be met by specifying and monitoring activities so that they are in compliance with the substantive requirements of these regulatory programs.

Long-term effectiveness and permanence. Alternative D1 would provide for future limitations of contact with non-hazardous material through site controls and land use restrictions. Each of these is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents remain since the material would remain in-place. These components, therefore, would not provide long-term effectiveness. Alternatives D2, D3, and D4 would minimize residual risk through removal and containment. Alternatives D2, D3, and D4 are adequate and reliable methods for minimizing human exposure, minimizing migration of the constituents, and would provide long-term effectiveness. Long-term effectiveness is enhanced in Alternative D2 through treatment.

Reduction of toxicity, mobility, or volume through treatment. Alternative D1 does not include any treatment technologies; therefore, there would be no reduction of toxicity, mobility or volume. Alternative D2 would provide for a reduction in toxicity through treatment. A reduction in mobility would be realized for Alternatives D2 and D4 through containment in Impound 8 and for Alternative D3 through containment at an off-site disposal facility. A net volume increase is expected through bioremediation pre-conditioning for Alternative D2; a lesser volume increase would be expected if conditioning was necessary to provide compressive strength for Alternatives D3 and D4.

Short-term effectiveness. Alternative D1 would provide for limitations of contact with the non-hazardous fill material through site controls and land use restrictions. There would be no anticipated impacts to the community from ground water and tar seep monitoring associated with this alternative. In Alternatives D2, D3, and D4, the community would be restricted from access to the site during remedial activities through locking gates currently in-place and an existing manned guardpost. Appropriate protective equipment would be used during monitoring activities in Alternative D1 and in remedial activities for Alternatives D2, D3, and D4. Appropriate mitigation measures would be implemented to control vapor emissions during excavation of the non-hazardous material in Alternatives D2, D3, and D4. Environmental impacts would not be minimized in Alternative D1, since migration of constituents to the ground water could continue for the in-place material. With respect to Alternatives D2, D3, and D4, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts.

With respect to the RAO, Alternative D1 would not provide for minimization of constituents. Alternative D2 would achieve the RAO upon completion of construction activities within approximately 2 to 3 yr. Alternatives D3 and D4 would achieve the RAO upon completion of construction activities within approximately 1 to 2 yr.

Implementability. Components of Alternative D1, including land use restrictions, ground water monitoring, and tar seep monitoring, are readily implementable and reliable for their intended functions. Alternative D2 and D4 are also readily implementable based upon the availability of Impound 8. Alternative D3 is readily implementable assuming that the characterization of the material is acceptable to the off-site disposal facility with no further treatment. Coordination with the NJDEP would be required for implementation of air pollution controls associated with materials conditioning for Alternatives D2, D3 and D4. Alternative D2 would also require air pollution controls during active treatment.

Cost. Capital costs for each alternative were estimated. O&M and total present worth costs were estimated for Alternative D1. For Alternatives D2 and D4, costs associated with the overall O&M of Impound 8 were not included. Similarly, costs associated with O&M of an off-site disposal facility were also not included. Alternative D1 is the least expensive alternative. Of the action alternatives, Alternative D4 is the least expensive alternative and Alternative D2 is the most expensive alternative.

A cost comparison of alternatives is as follows:

Alternate	Capital	O & M	30-yr Present Worth
D1 (no action/institutional controls)	$3,600	$14,000	$170,000
D2 (Bioremediation)	$17,000,000	N/A	$17,000,000
D3 (off-site disposal)	$10,000,000	N/A	$10,000,000
D4 (consolidation into Impound 8)	$1,800,000	N/A	$1,800,000

Regulatory agency acceptance. Regulatory agency acceptance will be documented in the ROD.

Community acceptance. Community acceptance will be documented in the ROD following public comment on the proposed plan.

ATTACHMENT 2

Compliance with ARARs. There are no chemical-specific ARARs associated with Alternative A1. Universal Treatment Standards (UTS) specified in EPA's Land Disposal Regulations (LDRs) are chemical-specific ARARS for Alternatives A2, A3, and A4 as the material would be removed from the impoundments and disposed in Impound 8. There are three possible ways to comply with this requirement: 1) achieve the UTSs, 2) obtain a treatability variance for soils and debris (using 6A guidance levels) or 3) granting a CAMU and developing alternative treatment standards. For Alternative A2, the third option associated with alternative treatment standards under a CAMU is the only way to meet this ARAR based on raw material characterization. LTTT testing performed to evaluate Alternative A3 proved that the treated material also did not achieve UTSs or treatability variance levels using the 6A guidance levels. Therefore, option 3 is also the only way for Alternative A3 to meet the ARAR. Alternative A4, on-site incineration, would be expected to meet either option 1 or option 2 through destruction of the organic material.

The New Jersey Flood Hazard Control Act Regulations (NJAC 7:13 et. seq.) would be a location-specific for each of the alternatives. This ARAR would be met through specifying the substantive floodplain requirements in the remedial action contract and by maintaining compliance through remedial action monitoring. In addition, the New Jersey Standards for New Hazardous Waste Facilities (NJAC 7:26-10.3) would be another location-specific ARAR for Alternatives A2, A3, and A4 as placement of the materials would be in Impound 8. This ARAR would be met for these alternatives by specifying the substantive requirements in the remedial action contract and by maintaining compliance with those requirements through remedial action monitoring.

Action-specific ARARs identified for Alternatives A1, A2, A3 and A4 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARS would be met through specifying the substantive requirements in the remedial action contract and by monitoring compliance during inspection activities. Additional action-specific ARARs would be triggered for Alternatives A2, A3 and A4 due to material excavation, conditioning and/or treatment, and placement in Impound 8. These ARARs would include New Jersey SESC requirements; New Jersey hazardous waste regulations related to residual waste disposal; DOT transport requirements: and RCRA regulations pertaining to Impound 8. These ARARs would also be met through specification of the substantive requirements in the remedial action contract documents and during remedial action monitoring to maintain compliance.

Attachment 1

Metals Summary Tables

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 1 - Metals Data Summary

	Total Metals				EP TOXICITY				TCLP				
Compounds	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Regulatory Level**
Metals (ppm)													
antimony	ND	ND	ND	0 of 3									
arsenic	0.3	3.7	2.1	3 of 3	0.5	0.7	0.6	2 of 2	<0.5	<0.5	<0.5	0 of 1	5
barium	ND	16.4	5.5	1 of 3	ND	ND	ND	0 of 2	<1.0	<1.0	<1.0	0 of 1	100
beryllium	ND	ND	ND	0 of 3									
cadmium	ND	ND	ND	0 of 3	ND	ND	ND	0 of 2	<0.005	<0.005	<0.005	0 of 1	1
chromium	15.3	36.9	18.5	3 of 3	0.1	0.6	0.4	2 of 2	0.02	0.02	0.02	1 of 1	5
copper	20.3	34.8	28.4	3 of 3									
cyanide	ND	ND	ND	0 of 3									
lead	60.5	100.0	86.5	3 of 3	0.2	1.5	0.9	2 of 2	<0.5	<0.5	<0.5	0 of 1	5
mercury	0.2	1.0	0.7	3 of 3	ND	0.0017	0.0017	1 of 2	<0.001	<0.001	<0.001	0 of 1	0.2
nickel	10.0	25.6	19.5	3 of 3									
selenium	3.8	3.9	3.9	3 of 3	ND	0.088	0.088	1 of 2	<0.1	<0.1	<0.1	0 of 1	1
silver	ND	3.3	1.1	1 of 3	ND	ND	ND	0 of 2	<0.01	<0.01	<0.01	0 of 1	5
vanadium	ND	ND	ND	0 of 3									
zinc	ND	9.3	3.1	1 of 3									

Total Metals Source: Group II CMS/FS (BB&L, 5/94)

EP Toxicity Source: Impoundment Characterization Program Report, BB&L, Amended August 1990

TCLP Source: Low Temp. Thermal Trtmnt Rpt,Phase II Conditioned Sludge, Group III CMS, O'Brien & Gere, April, 1996

ND - Not Detected

Results reported in a dry-weight basis

Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 2 - Metals Data Summary

	Total Metals				EP TOXICITY				TCLP				
Compounds	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Regulatory Level**
Metals (ppm)													
antimony	ND	ND	ND	0 of 3									
arsenic	4.2	24.4	13.1	3 of 3	0.3	0.7	0.5	2 of 2	<0.5	<0.5	<0.5	0 of 3	5
barium	18.0	62.3	31.5	3 of 3	ND	ND	ND	0 of 2	<1.0	<1.0	<1.0	0 of 3	100
beryllium	ND	ND	ND	0 of 3									
cadmium	ND	ND	ND	0 of 3	ND	ND	ND	0 of 2	<0.005	<0.005	<0.005	0 of 3	1
chromium	7.3	11.4	9.9	3 of 3	0.024	0.104	0.064	2 of 2	<0.01	<0.01	<0.01	0 of 3	5
copper	19.6	29.8	24.3	3 of 3									
cyanide	ND	ND	ND	0 of 3									
lead	99.5	127.0	116.8	3 of 3	ND	0.3	0.2	1 of 2	<0.5	<0.5	<0.5	0 of 3	5
mercury	1.1	2.6	1.7	3 of 3	0.0012	0.012	0.007	2 of 2	<0.001	<0.001	<0.001	0 of 3	0.2
nickel	ND	9.1	3.0	1 of 3									
selenium	8.6	13.8	10.9	3 of 3	ND	0.094	0.047	1 of 2	<0.5	<0.5	<0.5	0 of 3	1
silver	ND	ND	ND	0 of 3	ND	ND	ND	0 of 2	<0.01	<0.01	<0.01	0 of 3	5
vanadium	ND	ND	ND	0 of 3									
zinc	10.0	21.5	14.3	3 of 3									

Total Metals Source: Group II CMS/FS (BB&L, 5/94)
EP Toxicity Source: Impoundment Characterization Program Report, BB&L, Amended August 1990
TCLP Source: Low Temp. Thermal Trtmnt Rpt,Phase II Conditioned Sludge, Group III CMS, O'Brien & Gere, April, 1996
ND - Not Detected
Results reported in a dry-weight basis
Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 3- Metals Data Summary

	Total Metals				EP TOXICITY				
Compounds	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Regulatory Level**
Metals (ppm)									
antimony	ND	17.4	10.7	3 of 5					
arsenic	0.9	10.3	5.4	7 of 7	ND	ND	ND	0 of 5	5
barium	115	592	265	5 of 5	0.085	0.353	0.225	5 of 5	100
beryllium	ND	0.94	0.66	3 of 5					
cadmium	ND	5	3.5	3 of 7	ND	0.006	0.0002	2 of 5	1
chromium	64	1540	369	7 of 7	0.041	0.567	0.251	5 of 5	5
copper	28	812	281	7 of 7					
cyanide	ND	312	130	3 of 5					
lead	66.6	4480	924	7 of 7	ND	0.180	0.180	1 of 5	5
mercury	0.09	2	1.2	7 of 7	ND	ND	ND	0 of 5	0.2
nickel	21	65.9	39.5	7 of 7					
selenium	ND	0.72	0.4	4 of 7	ND	0.096	0.096	1 of 5	1
silver	ND	29.3	5.2	2 of 6	ND	ND	ND	0 of 5	5
vanadium	27.8	42.2	36	5 of 5					
zinc	81	2470	598	7 of 7					

Total Metals Source: Group III CMS/FS (BB&L, 5/95), Impoundment Characterization Program Report, BB&L, Amended August 1990

EP Toxicity Source: Impoundment Characterization Program Report, BB&L, Amended August 1990

No TCLP Data available

ND - Not Detected

Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 4- Metals Data Summary

Compounds	Min	Max	Mean	Detects
	Total Metals			
Metals (ppm)				
antimony				
arsenic	ND	101	35	3 of 5
barium				
beryllium				
cadmium	3	4	3.5	2 of 2
chromium	ND	14	4	2 of 5
copper	ND	20.3	9.3	4 of 5
cyanide				
lead	ND	65	24.6	4 of 5
mercury	ND	0.87	0.33	4 of 5
nickel	ND	5.4	1.5	2 of 5
selenium	ND	1.9	0.75	4 of 5
silver	ND	ND	ND	0 of 2
vanadium				
zinc	ND	35.1	17.6	4 of 5

Total Metals Source: Group III CMS/FS (BB&L, 5/95), Impoundment Characterization Program Report, BB&L, Amended August 1990

No EP Toxicity Data available

No TCLP Data available

ND - Not Detected

Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 5 - Metals Data Summary

	Total Metals								*EP TOXICITY*				
	Sludge				*Fill*								
Compounds	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Regulatory Level**
Metals (ppm)													
antimony	ND	22	4.4	3 of 9	ND	6.5	1.63	1 of 4					
arsenic	6.3	63	29.0	9 of 9	1	16.5	9	4 of 4	ND	0.20	0.0151	1 of 13	5.0
barium	102	7,480	2,502	9 of 9	63.8	229	115	4 of 4	ND	1.00	0.43	12 of 13	100
beryllium	ND	1.6	0.99	2 of 9	ND	2.1	0.53	1 of 4					
cadmium	ND	9.3	5.4	8 of 9	ND	0.85	0.21	1 of 4	ND	ND	ND	0 of 13	1.0
chromium	32	3,680	1,500	9 of 9	57.4	863	359	4 of 4	ND	0.18	0.074	11 of 13	5.0
copper	163	3,020	1,894	9 of 9	124	233	190	4 of 4					
cyanide	ND	51.3	26.0	7 of 9	ND	9.6	2.4	1 of 4					
lead	50	2,930	1,314	9 of 9	54.8	440	254	4 of 4	ND	0.11	0.056	2 of 13	5.0
mercury	5	199	82.3	9 of 9	0.79	4.3	2.1	4 of 4	ND	0.022	0.005	7 of 13	0.2
nickel	53	464	225	9 of 9	10.8	316	110	4 of 4					
selenium	ND	6.10	2.0	8 of 9	ND	0.8	0.61	3 of 4	ND	0.09	0.09	1 of 13	1.0
silver	ND	3.90	3.30	6 of 9	NA	NA	NA	NA	ND	ND	ND	0 of 13	5
vanadium	3	71	34.6	9 of 9	6	31	20.6	4 of 4					
zinc	115	3,190	837	9 of 9	141	2,130	838	4 of 4					

Total Metals Source: Group III CMS/FS (BB&L, 5/95), Impoundment Characterization Program Report, BB&L, Amended August 1990
EP Toxicity Source: Impoundment Characterization Program Report, BB&L, Amended August 1990
No TCLP Data available
Results reported in a dry-weight basis
Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 14 - Metals Data Summary

		Total Metals		
Compounds	**Min**	**Max**	**Mean**	**Detects**
Metals (ppm)				
antimony	ND	33	17	1 of 2
arsenic	ND	101	26	3 of 4
barium				
beryllium	ND	0.3	0.15	1 of 2
cadmium	ND	5	2.1	3 of 4
chromium	11	310	86	4 of 4
copper	40	730	371	4 of 4
cyanide				
lead	46.4	650	267	4 of 4
mercury	ND	40	17.6	3 of 4
nickel	4	68	36	4 of 4
selenium	0.02	2.4	0.62	4 of 4
silver	ND	0.3	0.075	1 of 4
vanadium				
zinc	81	810	458	4 of 4

Total Metals Source: Group III CMS/FS (BB&L, 5/95), Impoundment Characterization Program Report, BB&L, Amended August 1990
No EP Toxicity Data available
No TCLP Data available
Results reported in a dry-weight basis
Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 20 - Metals Data Summary

	Total Metals				TCLP				
Compounds	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Regulatory Limit**
Metals (ppm)									
antimony	28	663	391	3 of 3					
arsenic	6.26	8.4	7.33	2 of 2	ND	ND	ND	0 of 2	5
barium	38.6	40.5	39.6	2 of 2	0.6	2.61	1.605	2 of 2	100
beryllium	1.3	1.36	1.3	2 of 2					
cadmium	1.5	2.03	1.91	3 of 3	ND	ND	ND	0 of 2	1
chromium	1500	58,400	34,033	3 of 3	2.5	95	48.8	2 of 2	5
copper	1600	8270	5737	3 of 3					
cyanide	2.6	2.72	2.66	2 of 2					
lead	1000	1880	1480	3 of 3	ND	0.1	0.05	1 of 2	5
mercury	0.27	1.18	0.85	3 of 3	ND	ND	ND	0 of 2	0.2
nickel	240	462	379	3 of 3					
selenium	0.03	1.36	0.9	3 of 3	ND	0.2	0.1	1 of 2	1
silver	0.2	2.72	1.84	3 of 3	ND	0.01	0.005	1 of 2	5
vanadium	100	107	104	2 of 2					
zinc	13,800	148,000	80,900	2 of 2					

Total Metals Source: Group III CMS/FS (BB&L, 5/95), Impound 20 RDR, BB&L, October 1992

No EP ToxicityData available

TCLP Source: Impound 20 RDR, BB&L, October, 1992; Impoundment Characterization Program Report, BB&L, Amended August 1990

ND - Not Detected

Results reported in a dry-weight basis

Blank space indicates metal was not analyzed

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Impoundment 26 - Metals Data Summary

	Total Metals				EP TOXICITY				
Compounds	**Min**	**Max**	**Mean**	**Detects**	**Min**	**Max**	**Mean**	**Detects**	**Regulatory Level**
Metals (ppm)									
antimony	7.7	43.9	26.2	4 of 4					
arsenic	2.1	43.9	21.0	6 of 6	ND	ND	ND	0 of 4	5
barium	3.4	43.9	1789	4 of 4	0.8	1.24	1.05	4 of 4	100
beryllium	ND	0.6	0.60	1 of 4					
cadmium	7.7	51.2	21.6	6 of 6	0.1	0.3	0.3	4 of 4	1
chromium	55	266	149	6 of 6	ND	ND	ND	0 of 4	5
copper	530	5290	2106	6 of 6					
cyanide	ND	2.3	1.9	3 of 4					
lead	668	38,200	7,770	6 of 6	0.2	3.6	1.8	4 of 4	5
mercury	2.1	16.8	5.4	6 of 6	ND	ND	ND	0 of 4	0.2
nickel	58.3	829	284	6 of 6					
selenium	1.4	7.6	2.1	4 of 6	ND	ND	ND	0 of 4	1
silver	3.7	21.7	10.7	6 of 6	ND	ND	ND	0 of 4	5
vanadium	17.1	61.9	42.4	4 of 4					
zinc	860	5820	2623	6 of 6					

Total Metals Source: Group III CMS/FS (BB&L, 5/95), Lagoon Characterization Report, OB&G, March 1983
EP Toxicity Source: Impoundment Characterization Program Report, BB&L, Amended August 1990
No TCLP Data available
ND - Not Detected
Results reported in a dry-weight basis
Blank space indicates metal was not analyzed

Attachment 2

Impoundments 5 and 26 Waste Classification Letters

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Let's protect our earth

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS WASTE MANAGEMENT
LANCE R. MILLER, DIRECTOR
CN 028
Trenton, N.J. 08625-0028
(609) 633-1408
Fax # (609) 633-1454

JAN 25 1991

Mr. Paul Brzozowski
Blasland Bouck & Lee
Raritan Plaza III
Fieldcrest Avenue
Edison, N.J. 08837

Re: American Cyanamid, Bound Brook, N.J.
Impoundment #5 (mixed fill)

Dear Mr. Brzozowski:

In your letter of January 25, 1990 you requested a Departmental opinion on the classification of the tar, fill and debris from the above referenced site. Please be advised that based on the information submitted, the waste is not a N.J. listed waste, a RCRA listed waste nor a RCRA characteristic waste. Additionally, after consideration of the factors listed in N.J.A.C. 7:26-8.6 (use of constituent list in generator specific hazardous waste determination) this waste would not be considered hazardous waste due to the presence of hazardous constituents. Of major importance to this determination is the fact that the waste will be treated and disposed of on-site, under the authority of the existing administrative consent order, the existing HSWA permit and records of decision. The plausible types of improper management to which this waste will be subjected will be minimized since we are confident that an environmentally sound on-site remedial method will be chosen. Should any off-site treatment and disposal be proposed, then this letter is no longer considered valid, and reclassification of this waste will be required prior to off-site shipment.

Very truly yours,

Shirlee Schiffman

Shirlee Schiffman, Chief
Bureau of Hazardous Waste
Regulation and Classification

PR75:nb

Let's protect our earth

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS WASTE MANAGEMENT
CN 028
Trenton, N.J. 08625-0028
(609) 633-1408
Fax # (609) 633-1454

OCT 30 1990

Mr. Paul Brzozowski
Blasland, Bouck & Lee
Raritan Plaza III
Fieldcrest Avenue
Edison, New Jersey 08837

RE: American Cyanamid
Bound Brook, New Jersey
Impoundment #26

Dear Mr. Brozozowski:

In response to your letter of January 25, 1990 for a Departmental opinion on the classification of approximately 22,000 cubic yards of waste from the above referenced site, please be advised that wastes which conform with the representative sample that provided the basis for data submitted to the Department are classified as industrial waste (I.D. #27) pursuant to the rules of the Division of Hazardous Waste Management. Wastes conforming with the characteristics of the representative samples must be disposed at the facility authorized to accept industrial waste (I.D. #27) in accordance with the State waste flow rules as contained in N.J.A.C. 7:26-6 et seq.

Be further advised that this letter constitutes merely an advisory opinion on the applicability of current New Jersey waste classification standards to a specific representative sample of a waste stream. It expresses no opinion regarding any particular waste shipment to the extent that its characteristics and content differ from the representative sample of a waste stream.

Moreover, because the Department has not examined, inspected or analyzed the wastes you propose to dispose, as represented in your letter of January 25, 1990, this response does not constitute any representation as to the actual chemical composition of said material.

Accordingly, prior to disposal of this waste, you may wish to contact the selected disposal facility to establish an analytical protocol which will satisfy all concerned parties that current regulations allow for such disposal.

Should you have any further questions regarding this matter, please contact Richard Johnson of this bureau at (609) 292-8341.

Very truly yours,

Shirlee Schiffman, Chief
Bureau of Hazardous Waste
Regulation and Classification

PR75:baw

c Wayne Howitz
  Al Kaczoroski

Attachment 3

Impound 8 Geotechnical Evaluation

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

O'BRIEN & GERE
ENGINEERS, INC.

August 8, 1996

Mr. Thomas M. Donohue
Project Manager
Environmental Affairs
Department of Environment and Safety
AMERICAN HOME PRODUCTS CORPORATION
5 Giralda Farms
Madison, NJ 07940

Re: Bound Brook Remedial Program
Impound 8 Facility
Debris Placement Evaluation

File: 5772.010 #9

Dear Tom:

The NJDEP has suggested limiting the size of debris placed in Impound 8 based on what appears to be a concern for the underlying liners. Landfills are typically designed to accept large debris without any detrimental effects. The purpose of this assessment is to document why placement of debris in Impound 8, within the context of the contract documents, will have no detrimental effect upon the underlying liner.

A cross section of the Impound 8 liner is shown in the attached Figure 1. The liner system consists of a composite liner, 16 inches of gravel used as a leachate collection system, and a non-woven geotextile fabric which inhibits fines from settling into the gravel layer. The solidified fill (typically using cement or kiln dust) to be placed in Impound 8 will have a minimum unconfined compressive strength of 25 psi.

A settlement analysis was conducted (as detailed below) to identify the appropriate approach for placement of rocks and debris in Impound 8 such that the placement will not adversely affect the liner system. For this settlement analysis, consideration was given on placement of debris directly on the solidified fill material, estimating the settlement as a function of load (debris weight/ft^2), and determining the estimated settlement of the largest anticipated piece of debris to be placed in Impound 8.

Based on this analysis, debris placed on the fill does not effect the stability of the liner system. Placement criteria for the Impound 8 facility will be established to require a minimum of two feet of solidified fill above the upper geotextile fabric layer as a precondition for placement of rocks and debris. Additionally, rocks and debris placement will not be allowed above the side slope area.

The Schmertmann equation for distortion settlement of a cohesionless mass was used for the analysis:

$$S_d = C_1 C_2 \Delta P \sum_{i=1}^{n} \left(\frac{I_z}{E}\right)_i \Delta Z_i$$

The equation is based on the distribution of vertical strain within a linear elastic half-space subjected to a uniformly distributed load over some area of the surface. C_1 and C_2 are correction factors for strain relief due to embedment of the load (debris) and for time-dependent increase of the settlement, respectively. ΔP is the net load intensity at the base of the debris, I_z is a strain influence factor, and E is Young's modulus at the mid point of the layer in question having a thickness of ΔZ_i. The unit weight of the solidified fill was taken as 60 lb/ft^3 with a blow count of 10 (calculation sheets attached).

The analysis indicated that a loading of 6,000 lb/ft^2 would be required to produce an initial (noticeable) settlement (after 1 day) of approximately 0.5 inches in the solidified fill. Under the same loading a settlement of about 1 inch is predicted after 10 years. This is significantly greater than the anticipated loading from construction debris. Actual debris is anticipated to weigh on the order of 150-200 lb/ft^3 (masonry and concrete rubble). Considering a concrete slab of 10 ft x 10ft x 1 ft as the largest piece of debris that could be placed by conventional equipment, the analysis indicates a settlement of approximately 0.2 inches after one day and 0.3 inches after 10 years. The slab in this case is placed flat on the fill producing a uniform loading of about 200 lb/ft^2 and a total load of 20,000 lb.

The predicted settlements are based on debris being placed directly on the fill with no additional fill placed adjacent to, or on top of the debris (C_1 = 1). In actual practice the debris would be buried, effectively surcharging the fill adjacent to the debris and further reducing the stress on the fill below the debris. The outcome is a reduction in settlement. For example if the debris was buried under one foot of fill the settlement would be reduced by about 25% with additional reduction as more fill was placed above the debris.

In summary, the analysis indicated that no significant settlement of debris would take place in the solidified fill and the fill material can accept loading well in excess of those anticipated due to debris placement without concern for detrimental settlement; therefore, placement of the anticipated debris is not size-dependent. It should be noted that the settlement of the debris does not cause movement of the fill in relation to the liner system below. Rather, the debris causes the fill to compress; this compression of the fill is noted as settlement of the debris. Therefore, the liner system can not be impacted by placement of debris above.

Based on the above analyses, no size restrictions are proposed for the placement of rocks and debris in Impound 8. However, consideration should be given to the potential for damage of the non-woven geotextile filter media at the top of the primary leachate layer. Therefore, the recommended placement procedure for construction debris should limit the placement of the material no closer than two-feet from any geotextile, geomembrane or geosynthetic material and debris should not be placed above the sideslopes where the gravel primary leachate layer is not present.

Please contact me if you should have any questions regarding the above evaluation.

Very truly yours,

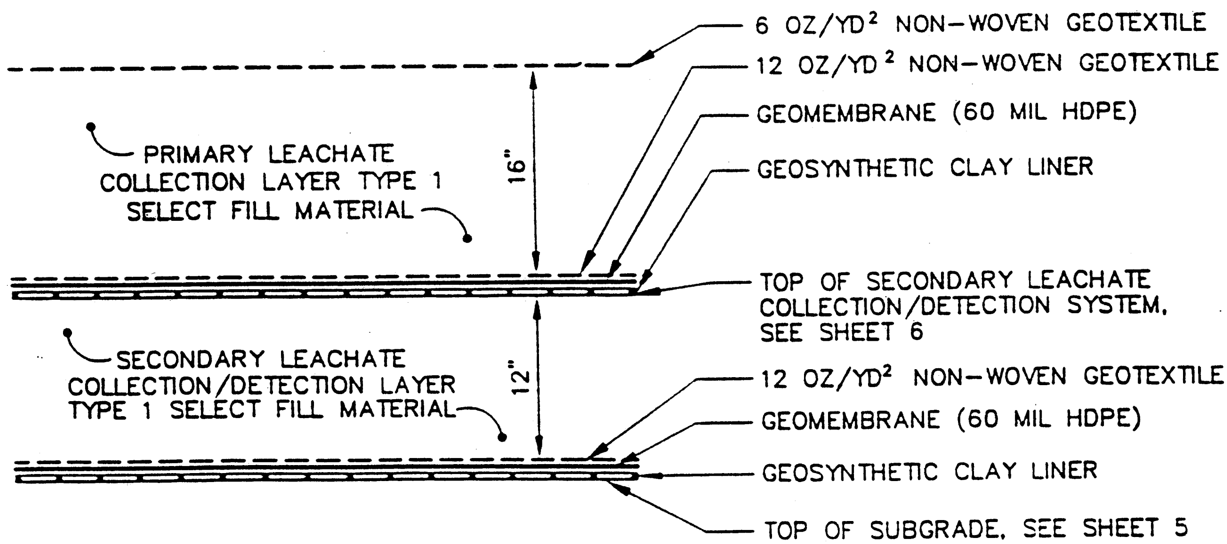
O'BRIEN & GERE ENGINEERS, INC.

Michael D. Zukauskas, P.E.
Senior Managing Engineer

MDZ:ndl
5772-010.100\ltr.138

cc: Mr. Angelo J. Caracciolo, III, O'Brien & Gere Engineers, Inc.
Mr. Steven T. Pernick, O'Brien & Gere Engineers, Inc.
Mr. Steven J. Roland, O'Brien & Gere Engineers, Inc.

FIGURE 1



TYPICAL BASE LINER SECTION (2)

NOT TO SCALE

NOTE:

INFORMATION BASED ON DRAWING PREPARED BY BLASLAND, BOUCK & LEE, CELL 2 CONSTRUCTION SHEET 10, FEBRUARY 1995.

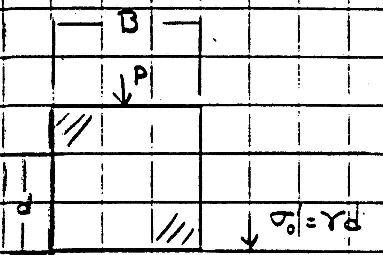
O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO.
AHPC: Imp 8 Debris Settlement	1	J	7/30/96	5772-010-437 (#8)

Re: Foundation Engineering Handbook, Winterkorn & Fang, 1975

General Equation for Distortion Settlement of Cohesionless Mass by Schmertmann:

$$S_d = C_1 C_2 \Delta p \sum_{i=1}^{n} \left(\frac{I_z}{E}\right)_i \Delta Z_i$$



Δp = net load at foundation depth

I_z = strain influence factor

E = Young's modulus at mid point of i-th layer of thickness ΔZ_i

$C_1 = 1 - 0.5\left(\frac{\sigma_0'}{\Delta p}\right) \geq 0.5$ = strain relief factor due to embedment

σ_0' = overburden pressure at foundation depth

$C_2 = 1 + 0.2 \log_{10}\left(\frac{t}{0.1}\right)$ = factor for time dependent settlement

t = time in years

Assumptions:

for stabalized fill - $\gamma = 60\#/ft^3$

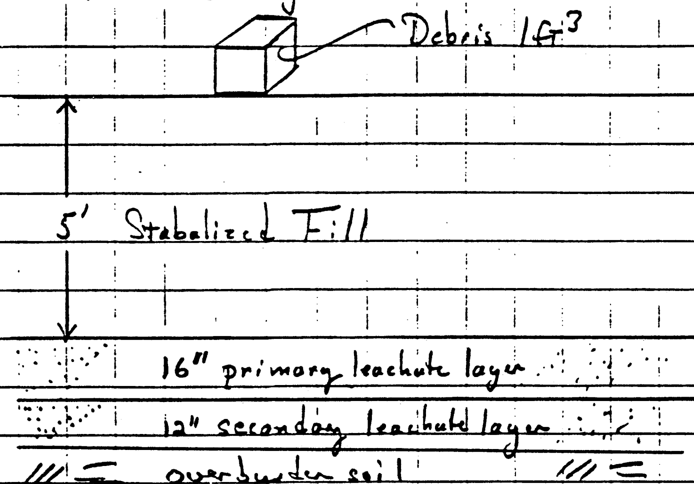
$N = 10$

O'BRIEN & GERE ENGINEERS, INC.

JECT	SHEET	BY	DATE	JOB NO.
AHPC: Imp 8 Debris Settlement	2	J	7/30/96	5772-010-437

Case Considered:

Debris placed on stabilized fill above primary gravel leachate layer

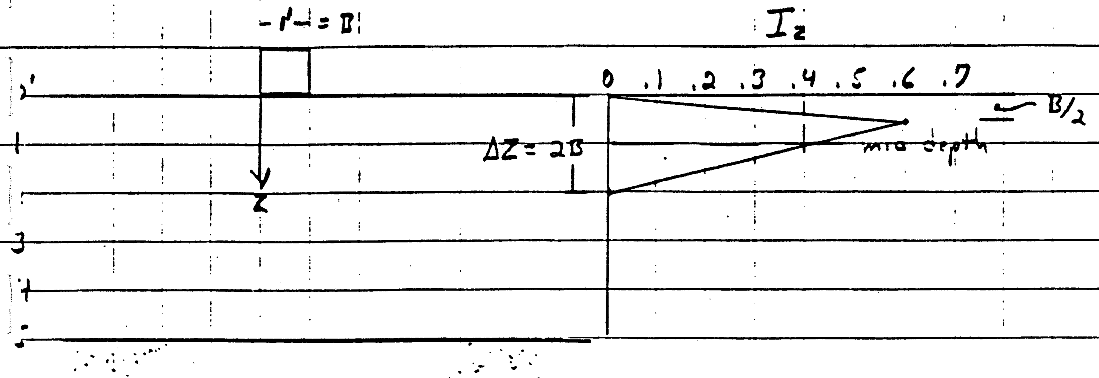


Determine:

1- Settlement as a function of load

2- Debris size as function of allowable settlement

1. Settlement as a function of load



$$S_d = C_1 C_2 \Delta p \sum \left(\frac{I_z}{E}\right)_i \Delta Z_i$$

$$= 1(0.69)\Delta p \sum \frac{0.4}{40}\, 2$$

$S_d = 0.0138\,\Delta p$ $t = 1$ day
ft   T/ft²

$= 0.0240$ $t = 1$ yr

$= 0.0268$ $t = 5$ y

$= 0.0280$ $t = 10$ yr

$B/2 = 0.5'$ @ $I_z = 0.6$

$Z/B = 2$

$\frac{Z}{1} = 2$

$Z = 2$ @ $I_z = 0$

$E = 2q_c$ $\frac{q_c}{N'} = 2$

$= 2(20)$ $q_c = 2N'$

$E = 40$ T/ft² $q_c = 2(10)$

$= 20$ T/ft²

$I_z = 0.4$ @ mid depth of layer

$C_1 = 1 - 0.5\left(\frac{\sigma_0'}{\Delta p}\right) \geq 0.5$

$= 1 - 0.5\left(\frac{0}{\Delta p}\right)$

$C_1 = 1$

$C_2 = 1 + 0.2 \log \frac{t}{0.1}$ $t = \frac{1}{365}$ yrs $= .0027$

$1 + 0.2 \log \frac{.0027}{0.1}$

$= 1 - 0.31$

$C_2 = 0.69$ @ $t = 1$ day

$= 1.20$ $t = 1$ yr

$= 1.34$ $t = 5$ yr

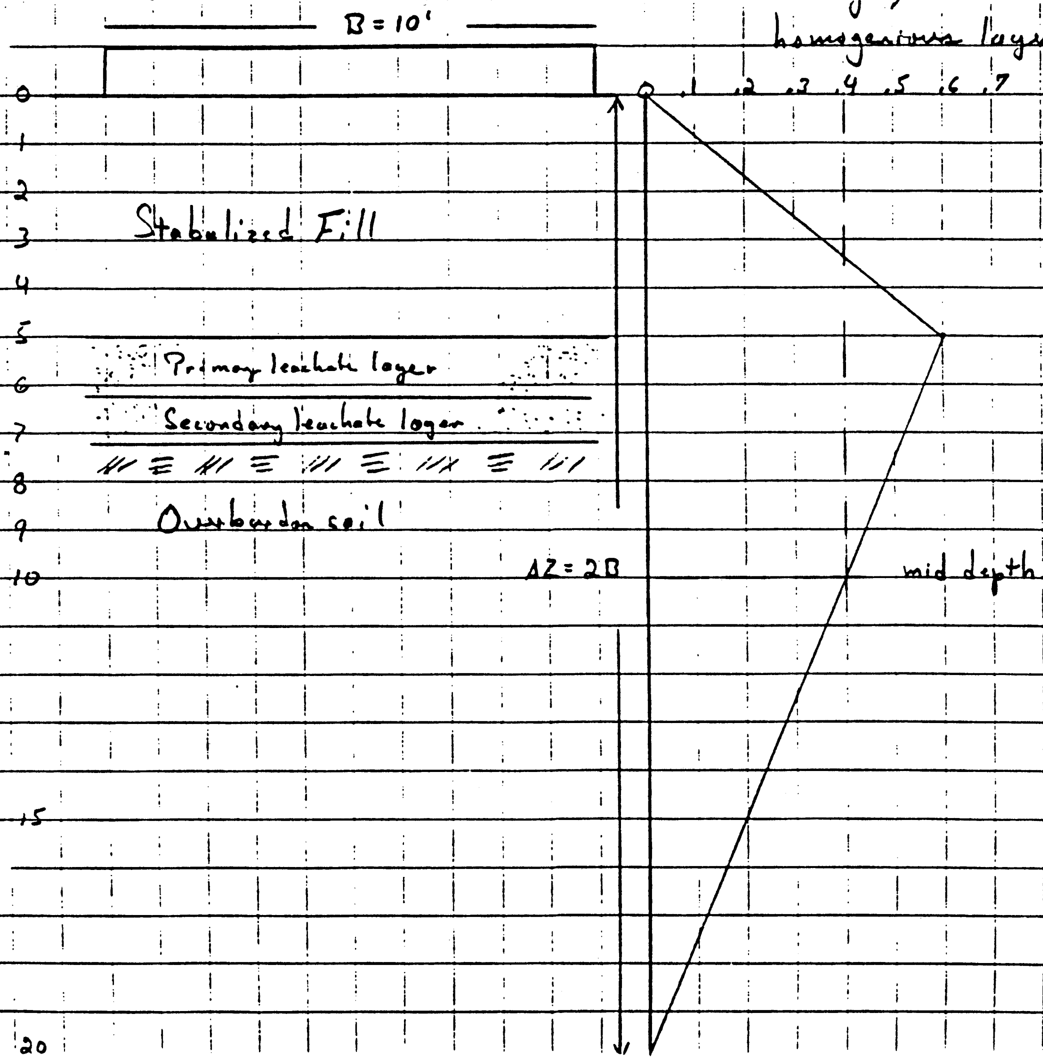
$= 1.40$ $t = 10$ yr

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO.
HPC: Imp 8 Debris Settlement	4		7/30/96	5772-010-437

Δp #/ft²	Δp T/ft²	S_d ft	@ t=1day S_d in	t=1yr S_d in	t=5yr S_d in	t=10yr S_d in
100	0.05	0.0007	0.0083	0.0144	0.0161	0.0168
→ 200	0.10	0.0014	0.0168	0.0288	0.0322	0.0336 ←
500	0.25	0.0035	0.0414	0.0720	0.0804	0.0840
1000	0.50	0.0069	0.0828	0.1440	0.1608	0.1680
2000	1.00	0.0138	0.1656	0.2880	0.3216	0.3360
5000	2.50	0.0345	0.4140	0.7200	0.8040	0.8400
6000	3.00	0.0414	0.4968	0.8640	0.9648	1.0080

2. Settlement for largest anticipated debris size
   - assume concrete @ 200#/ft3
   - 10' X 10' X 1' slab
   - consider all soil layers no stronger than (weakest) fill layer, therefore analize as one homogeneous layer



O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO.
HPC: Imp 8 Debris Settlement	5		7/30/96	5772-010-437

$S_d = C_1 C_2 \Delta p \sum \left(\frac{I_z}{E}\right)_i \Delta z_i$ $\Delta p = 200\ \#/ft^2 = 0.1\ T/ft^2$

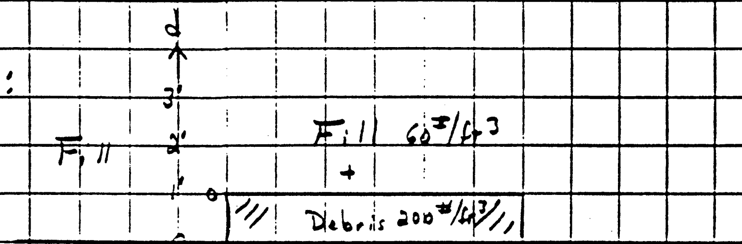
$= 1\ C_2\ 0.1 \sum \frac{0.4}{40} (20)$

$S_d = 0.02\ C_2$

@ t yrs	S_d in
1/365	0.11656
1	0.2880
5	0.3216
10	0.3360

Consider embedment (surcharge) affects:

$C_1 = 1 - 0.5 \frac{\sigma_0'}{\Delta p} \geq 0.5$



d	C_1	Reduction in Settlement (%)
0	1	0
1	0.85	15
2	0.77	23
5	0.66	34
10	0.60	40

d	x	γ_f	σ_0'	Δp	$\frac{\sigma_0'}{\Delta p}$
0		60 =	0	200	0
1		60	60	200	0.30
2		60	120	260	0.46
5		60	300	440	0.68
10		60	600	740	0.81

Attachment 4

Revised Treatment Objectives

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
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Determination of Proposed Treatment Objectives

- For **Maximum Compliance Values** the Treatment Objective was calculated using the maximum of the minimum values as described on the attached.

- For the low temperature thermal treatment **Average Compliance Values** the lesser of the Maximum Compliance Value or the 6A Variance level was utilized except for nitrobenzene where the pilot testing showed the 6A Variance level could not be met.

- For the bioremediation **Average Compliance Values** the lesser of the Maximum Compliance Value, or *the weighted average* treatment objective were ulsed. The exception was naphthalene which used the 6A Variance level. The weighted average levels were calculated by using the minimum pilot treatment level from each impoundment and applying a weighting factor based on volume of material within the impoundment. The following weighting factors were used:

Impoundment	Volume (cy)	Weighting Factor
4	900	0.007
5	104,800	0.78
14	4,000	0.030
20	7,800	0.058
26	17,600	0.13
Total:	135,100	1.00

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Description of Scale-up Factors

Treatment objectives must be established which are consistently attainable and demonstrated through compliance sampling once full scale treatment is implemented. To generate these objectives, the pilot-scale analytical results, which represent achievable levels for the Group III impoundment materials, must be adjusted to account for scale-up to full-scale treatment. The primary components of full-scale treatment that would affect the concentrations in the final treated material are:

- removal efficiency
- ability to analytically demonstrate the consistency of that removal.

These components are, in turn, dependent upon three variables, including:

- the consistency of material,
- the ability of the analytical method to accurately depict the constituent concentrations; and,
- the representative sampling of the treated materials

Scale-up factors based on standard statistical methods and regulatory guidance were developed to address these components.

- **Consistency of material.** The variability between pilot test treatment samples can be viewed as the standard deviation of the results (concentration value).

    - Three standard deviations away from the mean value incorporates variability inherent in approximately 99% of the sample analyses (Mendenhall and Sincich).

    - If viewed relative to the mean, it is anticipated that the compliance limit would still be exceeded, statistically, by one percent of the samples. This is not acceptable in establishing compliance levels for a full-scale system.

    - Threfore, applying three standard deviations to the achievable pilot test results ("maximum of the minimum" values), shift the confidence interval to account for the values which would exceed three standard deviations from the mean

- **Analytical method variability.** Analytical and instrumental variation will also affect the reported results. Both of these factors are routinely evaluated in the laboratory through the addition of external standards or surrogates to the samples.

    - Typically, analytical responses of 10% to 30% over the actual result can be observed and are accepted by regulatory agencies. This is standard within approved analytical methodologies such as SW846 and CLP.SOW OLM01.0.

    - An adjustment of 10% will be utilized to account for analytical variability.

- **Representative sampling.** Sample collection of heterogenous materials, such as those present within the Group III Impoundments, also provides a recognized variability in meeting established limits.

    - The NJDEP has adopted the use of compliance criteria for environmental remediations requiring sampling (Site Remediation News, Spring 1995, Volume 7, Number 2). This includes the use of a "maximum allowable concentration" in determining compliance. This method prevents indicating non-compliance based on a result which may not be representative of a prevailing condition.

    - The NJDEP has accepted the use of five times the analytical result, with a ceiling of 200 ppm, as appropriate in developing compliance criteria.

Development of scale-up factors.
The treatment objectives will be developed using the following application of adjustment factors:

- Determine treatment levels for each compound of concern based on the "maximum of the minimum" treatability results.

- Add three standard deviations to each level to account for *inconsistency of material* during treatment.

- Adjust the result by 10% to account for *analytical variability*.

- Multiply the resultant by 5 and/or compare to the ceiling of 200 ppm to account for *sampling variability*.

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Sample calculation for determining the bioremediation treatment objective for benzene

Step 1: Determine the maximum of the minimum concentrations for benzene. The minimum values for each impoundment (in bold) were determined from the Week 3, 6, and 9 values for the treated material.

Impoundment 4			Impoundment 5		
Wk 3	Wk 6	Wk 9	Wk 3	Wk 6	Wk 9
12	1.8	**1.2**	5.43	2.38	**1.09**

Impoundment 14			Impoundment 20			Impoundment 26		
Wk 3	Wk 6	Wk 9	Wk 3	Wk 6	Wk 9	Wk 3	Wk 6	Wk 9
1.78	2.95	1.98	3.6	1.41	**0.61**	0.0024	1.15	**0.001**

Compound	Minimum					Max of Minimum
	I-4	I-5	I-14	I-20	I-26	
Compounds of Concern						
Benzene	1.2	1.09	**1.78**	0.610	0.001	1.78

The maximum of the minimum for benzene: 1.78

Step 2: Determine the overall average of all of the data points (Weeks 3, 6 & 9) in all impoundments (4, 5, 14, 20 & 26).

AVG = (12 + 1.8 + 1.2 + 5.43 + 2.38 + 1.09 + 1.78 + 1.98 + 2.95 +1.98 + 3.6 + 1.41 + 0.61 + 0.0024 + 1.15 + 0.00052) / 15

AVG = 2.49

Step 3: Determine the standard deviation of the set of values used above in Step 2.

STDS = 2.98

Step 4: Determine the weighted average of the minimums:

I-4: 1.2 ppm x 0.007 (weighting factor) = 0.01
I-5: 1.09 ppm x 0.78 = 0.85
I-14: 1.78 ppm x 0.03 = 0.05
I-20: 0.61 ppm x 0.058 = 0.035
I-26: 0.001 ppm x 0.13 = 0.0001

Weighted average = 0.01 + 0.85 + 0.05 + 0.035 + 0.0001 = 0.94 ppm

Step 5: To adjust for inconsistency of material, three standard deviations were added to the maximum of the minimum treated value and the weighted average. The adjusted value for three standard deviations:

Adj. Value = Max. of Minimum + (3 x STDS)

= 1.78 + (3 x 2.98)

= 10.7

Note: The Max. of the Minimum in this case is actually lower than the average.

Adj. Value = Weighted Average + (3 x STDS) = 9.9

Step 6: To adjust for analytical variability, ten percent was added to the adjusted values calculated in step 4.

10% Lab. Variance = Adj. Value x 1.10

= 10.7 x 1.10 = 12 (for the Maximum Compliance Value)

= 9.9 x 1.10 = 10.9 (for the Average Compliance Value)

Step 7: To adjust for inconsistency of sampling from a heterogenous materials, a scale-up factor of five times the analytical results with a ceiling of 200 ppm was applied:

5X Scale-up = 10% Lab. Variance x 5

= 12 x 5 = 60 (for the Maximum Compliance Value)

= 10.9 x 5 = 54 (for the Average Compliance Value)

Step 8: Since 60 ppm and 54 ppm are below the ceiling of 200 ppm, they will be used as the Treatment Objective-Maximum and Average Compliance Values, respectively.

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Development of Revised Treatment Objectives

Biotreatment Objective Analysis (mg/kg)

Compound	Minimum					Max of Minimum	Overall Average	Overall Std. Dev.	Adj. for 3 Std. Dev.	Adj. for 10% Lab Var.	5X Scale-up	Revised treatment Obj.	Orig. treatment Obj.	Maximum Feed	Percent Reduction
	I-4	I-5	I-14	I-20	I-26										
Compounds of Concern															
Benzene	1.20	1.09	1.78	0.610	0.001	1.78	2.49	2.98	10.7	12	60	**60**	200	21,000	99.7%
Toluene	0.759	2.84	2.80	0.187	0.008	2.84	4.94	7.89	26.5	29	145	**145**	200	3100	95.3%
Xylene (total)	1.18	3.63	2.00	50.900	0.007	50.9	30.5	52.0	207	230	1150	**230**	500	5,500	95.8%
Naphthalene	250	3360	2850	9.17	9.59	3360	3490	5024	18432	20,300	101,500	**20,300**	13,100	240,000	91.5%
2-Methylnaphthalene	61.0	591.00	309	3.80	3.42	591.00	299	377	1721	1900	9500	**1900**	2300	12,000	84.2%
Nitrobenzene	3.80	71.8	1850	4.30	4.47	1850	517	981	4792	5300	26,500	**5300**	5200	< 9000	41.1%
1,2-Dichlorobenzene	77.7	20.4	4.37	1.37	11.7	77.7	48.5	70.0	288	320	1600	**320**	500	1700	81.2%
N-Nitrosodiphenylamine	14.8	967.00	6390	17.6	6.61	6390	1878	3340	16409	18,100	90,500	**18,100**	14,300	22,000	17.7%

LTTT Treatment Objective Analysis (mg/kg)

Compound	Min 2VR-1	Min 2MIX-1	Min 2HC-1	Min 1MIX-1	Max of Minimum	Overall		Adj. for 3 Std Dev	Adj. for 10% Lab Var	5X Scale-up	Revised treatment ob	Orig. treatment 0bj.	Maximum Feed	Percent Reduction
						Avg	Std Dev							
Compounds of Concern														
Benzene	0.0068	0.17	0.243	0.118	0.243	2.67	5.15	15.7	17	85	**85**	----	61,000	99.9%
Toluene	0.0065	0.424	0.323	0.0408	0.424	7.88	19.9	60.0	66	330	**200**	----	16,200	98.8%
Xylenes (total)	0.001	0.0855	0.219	0.0167	0.219	5.18	6.98	21.2	23	115	**115**	----	3440	96.7%
Naphthalene	0.053	1.50	0.885	0.448	1.5	159	204	613	670	3350	**670**	----	24000	97.2%
2-Methylnaphthalene	0.043	0.617	0.424	0.535	0.617	19.2	22.8	68.9	76	380	**200**	----	1700	88.2%
Nitrobenzene	0.05	1.30	1.4	1.20	1.40	5.20	9.39	29.6	33	165	**165**	----	1330	87.6%
1,2-Dichlorobenzene	0.05	0.793	1.06	1.40	1.40	19.696	18.1	55.8	61	305	**200**	----	11000	98.2%
N-Nitrosodiphenylamine	0.023	0.61	0.65	0.57	0.65	0.608	0.141	1.07	1	5	**5**	----	150	96.7%

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Proposed Treatment Objectives

LTTT

Compound of Concern	Feed Data	6A Variance Treatment Level			% Red.	Average Compliance Value	% Red.	Maximum Compliance Value	% Red.
Benzene	61,000	61	-	6,100	90%	85	99.9%	85	99.9%
Toluene	16,200	162	-	1,620	90%	200	98.8%	200	98.8%
Xylene	3,440	34	-	344	90%	115	96.7%	115	96.7%
Naphthalene	11,000	110	-	550	95%	550	95.0%	670	93.9%
Nitrobenzene	1,330	3	-	10	99.9%	165	87.6%	165	87.6%
1,2- dichlorobenzene	6,100	6	-	610	90%	200	96.7%	200	96.7%
N-Nitrosodiphenylamine	150	2	-	15	90%	5	96.7%	5	96.7%
2-Methylnaphthalene	1,520	15	-	76	95%	76	95.0%	200	86.8%

BIOTREATMENT

Compound of Concern	Feed Data	6A Variance Treatment Level			% Red.	Average Compliance Value	% Red.	Maximum Compliance Value	% Red.
Benzene	21,000	21	-	2,100	90%	54	99.7%	60	99.7%
Toluene	3,100	31	-	310	90%	145	95.3%	145	95.3%
Xylene	5,500	55	-	550	90%	180	96.7%	230	95.8%
Naphthalene	240,000	2,400	-	12,000	95%	12,000	95.0%	13,100	94.5%
Nitrobenzene	8,500	3	-	10	99.9%	3,360	60.5%	5,200	38.8%
1,2- dichlorobenzene	1,500	1	-	150	90%	250	83.3%	320	78.7%
N-Nitrosodiphenylamine	21,000	210	-	2,100	90%	12,000	42.9%	14,300	31.9%
2-Methylnaphthalene	9,200	92	-	460	95%	1,760	80.9%	1,900	79.3%

Note:
1. Average Compliance Value represents a six-month average concentration.
2. Maximum Compliance Value represents the maximum allowable concentration prior to placement in Impound 8.

Attachment 5

UTS and 6A Variance Evaluation

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AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Revised Treatment Objective	UTS
COMPOUNDS OF CONCERN							
benzene	21,000	100	0.5 - 10	90 - 99.9	21 - 2100	60	10
toluene	3,100	100	0.5 - 10	90 - 99	31 - 310	145	10
xylenes (total)	5,500	100	0.5 - 10	90 - 99	55 - 550	230	30
naphthalene	***240,000***	***400***	***0.5 - 20***	***95 - 99***	***2400 - 12000***	***13,100***	***6***
nitrobenzene	***< 8,500***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***5200***	***14***
1,2-dichlorobenzene	1,500	200	0.5 - 20	90 - 99.9	1.5 - 150	320	6
N-nitrosodiphenylamine	***21,000***	***100***	***0.5 - 10***	***90 - 99***	***210 - 2100***	***14,300***	***13***
2-methylnaphthalene	***9,200***	***400***	***0.5 - 20***	***95 - 99***	***92.0 - 460***	***1900***	***7***
HALOGENATED NON-POLAR AROMATICS		***100***	***0.5 - 10***	***90 - 99.9***			
1,4-dichlorobenzene	***< 960***	***100***	***0.5 - 10***	***90 - 99.9***	***0.96 - 96***	***170***	***6***
hexachlorobenzene	< 1,200	100	0.5 - 10	90 - 99.9	1.20 - 120	100	10
1,2,4-trichlorobenzene	***2,700***	***100***	***0.5 - 10***	***90 - 99.9***	***2.70 - 270***	***1300***	***19***
HALOGENATED PHENOLS		***400***	***0.5 - 40***	***90 - 99***			
4-chloroaniline	< 1,200	400	0.5 - 40	90 - 99	12.0 - 120	115	16
2-chlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***5.7***
4-chloro-3-methylphenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***14***
2,4-dichlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***14***
pentachlorophenol	< 6,100	400	0.5 - 40	90 - 99	61.00 - 610	200	7.4
2,4,5-trichlorophenol	< 6,100	400	0.5 - 40	90 - 99	61.00 - 610	200	7.4
2,4,6-trichlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***7.4***
HALOGENATED ALIPHATICS		***40***	***0.5 - 2***	***95 - 99.9***			
bromodichloromethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	15
bromoform	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	3	15
bromomethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	15
carbon tetrachloride	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
chloroethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	6
chloroform	800	40	0.5 - 2	95 - 99.9	0.80 - 40	15	6
chloromethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	30
dibromochloromethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	1	15
1,1-dichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,2-dichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,1-dichloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
trans-1,2-dichloroethylene	-	40	0.5 - 2	95 - 99.9	0.50 - 2	5	30
1,2-dichloropropane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	18

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Revised Treatment Objective	UTS
cis-1,3-dichloropropene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	18
trans-1,3-dichloropropene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	3	18
hexachlorobutadiene	< 1,200	40	0.5 - 2	95 - 99.9	1.20 - 60	100	5.6
hexachloroethane	< 1,200	40	0.5 - 2	95 - 99.9	1.20 - 60	165	30
methylene chloride	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	30
1,1,2,2-tetrachloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	2	6
tetrachloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	25	6
1,1,1-trichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,1,2-trichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
trichloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
vinyl chloride	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	10	6
HALOGENATED CYCLICS		200	0.5 - 20	90 - 99.9			
chlorobenzene	4,100	200	0.5 - 20	90 - 99.9	4.1 - 410	200	6
2-chloronaphthalene	< 1,200	200	0.5 - 20	90 - 99.9	1.20 - 120	200	5.6
1,3-dichlorobenzene	< 1,200	200	0.5 - 20	90 - 99.9	1.20 - 120	70	6
hexachlorocyclopentadiene	< 1,200	200	0.5 - 20	90 - 99.9	1.20 - 120	185	2.4
NITRATED AROMATICS		10,000	2.5 - 10	99.9 - 99.99			
4,6-dinitro-o-cresol	< 6,100	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	200	160
2,4-dinitrotoluene	< 1,200	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	200	140
2,6-dinitrotoluene	< 1,200	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	125	28
2-nitroaniline	< 6,100	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	125	14
3-nitroaniline	< 6,100	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	135	14
4-nitroaniline	< 4,800	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	85	28
2-nitrophenol	< 1,200	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	200	13
4-nitrophenol	< 6,100	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	200	29
POLYNUCLEAR AROMATICS		400	0.5 - 20	95 - 99			
acenaphthene	1,200	400	0.5 - 20	95 - 99	12.0 - 60	380	3.4
anthracene	560	400	0.5 - 20	95 - 99	5.6 - 28	210	3.4
benzo(a)anthracene	490	400	0.5 - 20	95 - 99	4.9 - 24.5	1000	3.4
benzo(a)pyrene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	75	3.4
benzo(b)fluoranthene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	65	6.8
benzo(g,h,i)perylene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	60	1.8
benzo(k)fluoranthene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	125	6.8
chrysene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	75	3.4
dibenzo(a,h)anthracene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	85	8.2

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Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Revised Treatment Objective	UTS
fluoranthene	***< 960***	***400***	***0.5 - 20***	***95 - 99***	***9.6 - 48***	***200***	***3.4***
fluorene	***3,200***	***400***	***0.5 - 20***	***95 - 99***	***32.0 - 160***	***650***	***3.4***
indeno(1,2,3-cd)pyrene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	40	3.4
phenathrene	***1,300***	***400***	***0.5 - 20***	***95 - 99***	***13 - 65***	***390***	***5.6***
pyrene	***< 960***	***400***	***0.5 - 20***	***95 - 99***	***10 - 48***	***200***	***8.2***
OTHER POLAR ORGANICS		***100***	***0.5 - 10***	***90 - 99***			
acetone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	160
benzoic acid	-	***100***	***0.5 - 10***	***90 - 99***	***0.5 - 10***	***200***	***8***
bis(2-chloroethoxy) methane	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***125***	***7.2***
bis(2-chloroethyl)ether	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	85	6
bis(2-ethylhexyl)phthalate	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***28***
4-bromophenyl phenyl ether	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	75	15
2-butanone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	36
butyl benzyl phthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	30	28
carbon disulfide	< 790	100	0.5 - 10	90 - 99	7.90 - 79	5	4.8
diethylphthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	75	28
2,4-dimethylphenol	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***14***
dimethylphthalate	3,400	100	0.5 - 10	90 - 99	34 - 340	75	28
di-n-butyl phthalate	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***28***
2,4-dinitrophenol	< 6,100	100	0.5 - 10	90 - 99	61.00 - 610	200	160
di-n-octyl phthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	65	28
ethylbenzene	***1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***165***	***10***
2-hexanone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	33
phenol	***< 960***	***100***	***0.5 - 10***	***90 - 99***	***9.6 - 96***	***200***	***6.2***

Notes: Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Bioremediation field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used.

(2) If compound analytical result is less than threshold value, then concentration range is shown.

(3) Other technologies may be used if treatability studies or other information indicates that they can achieve the necessary concentration of percent-reduction range.

(4) TCLP also may be used when evaluating material with relatively low levels of organics that have been treated through an immobilization process.

(5) Shown as the concentration range if the analytical result is less than the threshold value, and as the percent reduction of the feed data if the analytical result is greater than the threshold value.

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Revised Treatment Objective
COMPOUNDS OF CONCERN						
benzene	61,000	100	0.5 - 10	90 - 99.9	61 - 6100	85
toluene	16,200	100	0.5 - 10	90 - 99	162 - 1620	200
xylenes (total)	3,440	100	0.5 - 10	90 - 99	34 - 344	115
naphthalene	* 11,000	400	0.5 - 20	95 - 99	110 - 550	670
nitrobenzene	***1,330***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***165***
1,2-dichlorobenzene	* 6,100	200	0.5 - 20	90 - 99.9	6.1 - 610	200
N-nitrosodiphenylamine	150	100	0.5 - 10	90 - 99	2 - 15	5
2-methylnaphthalene	**** 1,520***	***400***	***0.5 - 20***	***95 - 99***	***15 - 76***	***200***
HALOGENATED NON-POLAR AROMATICS		***100***	***0.5 - 10***	***90 - 99.9***		
1,4-dichlorobenzene	* 1,200	100	0.5 - 10	90 - 99.9	1.20 - 120	30
hexachlorobenzene	< 180	100	0.5 - 10	90 - 99.9	0.18 - 18	15
1,2,4-trichlorobenzene	70	100	0.5 - 10	90 - 99.9	0.50 - 10	10
HALOGENATED PHENOLS		***400***	***0.5 - 40***	***90 - 99***		
4-chloroaniline	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	15
2-chlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	25
4-chloro-3-methylphenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	25
2,4-dichlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	30
pentachlorophenol	*< 890	400	0.5 - 40	90 - 99	8.90 - 89	30
2,4,5-trichlorophenol	*< 890	400	0.5 - 40	90 - 99	8.90 - 89	25
2,4,6-trichlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	20
HALOGENATED ALIPHATICS		***40***	***0.5 - 2***	***95 - 99.9***		
bromodichloromethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
bromoform	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	5
bromomethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	2
carbon tetrachloride	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
chloroethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1
chloroform	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1
chloromethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1
dibromochloromethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
1,1-dichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
1,2-dichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
1,1-dichloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
trans-1,2-dichloroethylene	< 280	40	0.5 - 2	95 - 99.9	0.28 - 14	1
1,2-dichloropropane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Revised Treatment Objective
cis-1,3-dichloropropene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
trans-1,3-dichloropropene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
hexachlorobutadiene	*< 180	40	0.5 - 2	95 - 99.9	0.2 - 9	10
hexachloroethane	*< 180	40	0.5 - 2	95 - 99.9	0.2 - 9	20
methylene chloride	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
1,1,2,2-tetrachloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	5
tetrachloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
1,1,1-trichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
1,1,2-trichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
trichloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1
vinyl chloride	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	2
HALOGENATED CYCLICS		200	0.5 - 20	90 - 99.9		
chlorobenzene	*< 1,100	200	0.5 - 20	90 - 99.9	1.1 - 110	1
2-chloronaphthalene	378	200	0.5 - 20	90 - 99.9	0.4 - 37.8	50
1,3-dichlorobenzene	* 190	200	0.5 - 20	90 - 99.9	0.50 - 20	10
hexachlorocyclopentadiene	< 180	200	0.5 - 20	90 - 99.9	0.50 - 20	20
NITRATED AROMATICS		10,000	2.5 - 10	99.9 - 99.99		
4,6-dinitro-o-cresol	*< 890	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	30
2,4-dinitrotoluene	*< 63	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	20
2,6-dinitrotoluene	*< 180	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	15
2-nitroaniline	*< 890	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	15
3-nitroaniline	*< 890	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	15
4-nitroaniline	*< 890	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	10
2-nitrophenol	*< 180	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	35
4-nitrophenol	*< 890	10,000	2.5 - 10	99.9 - 99.99	2.5 - 10	50
POLYNUCLEAR AROMATICS		400	0.5 - 20	95 - 99		
acenaphthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	90
anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	55
benzo(a)anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10
benzo(a)pyrene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10
benzo(b)fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10
benzo(g,h,i)perylene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5
benzo(k)fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	20
chrysene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5
dibenzo(a,h)anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Revised Treatment Objective
fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	15
fluorene	**** 2,800***	***400***	***0.5 - 20***	***95 - 99***	***28.0 - 140***	***200***
indeno(1,2,3-cd)pyrene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5
phenathrene	** 360*	*400*	*0.5 - 20*	*95 - 99*	*0.5 - 20*	*50*
pyrene	* 40	400	0.5 - 20	95 - 99	1 - 20	10
OTHER POLAR ORGANICS		***100***	***0.5 - 10***	***90 - 99***		
acetone	< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	15
benzoic acid	884	100	0.5 - 10	90 - 99	8.8 - 88.4	80
bis(2-chloroethoxy) methane	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	15
bis(2-chloroethyl)ether	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10
bis(2-ethylhexyl)phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10
4-bromophenyl phenyl ether	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10
2-butanone	*< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	3
butyl benzyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5
carbon disulfide	*< 1,100	100	0.5 - 10	90 - 99	11.00 - 110	2
diethylphthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10
2,4-dimethylphenol	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5
dimethylphthalate	*< 180	100	0.5 - 10	90 - 99	2 - 18	10
di-n-butyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5
2,4-dinitrophenol	*< 890	100	0.5 - 10	90 - 99	8.90 - 89	65
di-n-octyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5
ethylbenzene	****< 1,100***	***100***	***0.5 - 10***	***90 - 99***	***11.0 - 110***	***200***
2-hexanone	*< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	1
phenol	240	100	0.5 - 10	90 - 99	2.4 - 24	20

Notes: Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Low Temperature Thermal Treatment field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used. Results indicated with "*" are drawn from the Impoundment 3 Bioremediation field pilot study.

(2) If compound analytical result is less than threshold value, then concentration range is shown.

(3) Other technologies may be used if treatability studies or other information indicates that they can achieve the necessary concentration of percent-reduction range.

(4) TCLP also may be used when evaluating material with relatively low levels of organics that have been treated through an immobilization process.

(5) Shown as the concentration range if the analytical result is less than the threshold value, and as the percent reduction of the feed data if the analytical result is greater than the threshold value.

Attachment 6

Remedial Alternative Timeframe Analysis

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS

Group B Category
Remedial Timeframe Analysis

Alternative B3 - Bioremediation

Contract Procurement and Operations Plan	3 mos.
Permitting and Construction	6 mos.
Operation (262,000 yd^3 bulked; 125 yd^3/day; no downtime)	70 mos.
Site Restoration and Demobilization	6 mos.
Total:	85 mos.
Range:	5 - 7 years

Alternative B4 - LTTT

Contract Procurement and Operations Plan	3 mos.
Permitting and Mobilization	6 mos.
Excavation and Staging	6 mos.
Operation (115,000 tons conditioned; 10 tons/hr; 75% on-line)	21 mos.
O&M Shutdowns	3 mos.
Site Restoration and Demobilization	6 mos.
Total:	43 mos.
Range:	3 - 4 years

Attachment 7

Remedial Alternatives for Material Category D

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, New Jersey

Group III Impoundments Corrective Measures Study/Feasibility Study

Category D: Non-Hazardous Material

Four remedial alternatives were developed for Category D. As discussed in Sections 4 and 5 of the April 1996 Group III CMS/FS, existing TCLP characterization data indicate that the non-sludge (Impoundment 5 dry fill and Impoundment 26) material does not exhibit the characteristics of a RCRA hazardous waste. Based on comments received from the New Jersey Department of Environmental Protection and United States Environmental Protection Agency on the Group III CMS/FS, treatment of the Category D materials should be addressed within the CMS/FS based on the total contaminant levels within Impoundments 5-dry and 26. Consequently, the alternatives assembled include no action/institutional actions, treatment via bioremediation, off-site disposal as a non-hazardous waste, and consolidation in Impound 8.

Alternative D1- no action/institutional actions

Alternative D1, no action/institutional actions, required by NCP, provides a baseline for comparison to the other alternatives. Alternative D1 consists of only access restrictions and monitoring. Access restrictions would include maintenance of the existing site controls which restrict access to the impoundments as well as future land use restrictions due to the continuing presence of the fill material in place. Ground water monitoring would be performed as part of Alternative D1 to track the impact to site ground water from the impoundments. Monitoring and maintenance of tar seeps would also be performed.

Alternative D2- bioremediation with final placement in Impound 8

Alternative D2, solid-phase bioremediation, involves treatment of the material using solid-phase bioremediation and placement of the treated materials in the Impound 8 facility.

Material handling. The category D material would be removed from the impoundments using standard excavation techniques, such as long-reach excavator, backhoe, or clamshell and crane. The excavation would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the impoundment materials.

Treatment. Biological processing using modified compost or aerated pile techniques would be used for treatment. Compost process alternative include:

- forced air assisted windrow composting
- forced air assisted solid phase continuous flow composting

In each case, aeration would be provided by subgrade collection ducts drawing air from the atmosphere through the impoundment materials for treatment and discharge. Windrow mixing would typically be provided by a straddle-type tiller , while the continuous mixing provides a mechanical tiller that tracks along bay walls containing the treatment medium. In the latter case, material to be treated is also moved forward a pre-determined distance allowing material to be added at the feed end and removed at the opposite end. Moisture and nutrient levels would be monitored and maintained, as necessary, based on the results of the pre-design testing. Biological treatment using indigenous microorganisms with a treatment duration of 21 days is anticipated. A portion of the finished compost may be recycled to the feed, however, to reduce acclimation or lag time. Finished compost ma be cured in passive piles if additional polishing is required.

The treated material would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility. Post-conditioning would involve the addition of stabilizing agents such as Portland cement, sodium silicate, and moisture.

During the remedial design, the viability of utilizing the category D material as an admixture for other material categories will be address.

Final placement. Treated category D material would be sampled and analyzed to confirm achievement of Group III treatment objectives for indicator compounds of concern and unconfined compressive strength requirements. The frequency of treatment evaluation sampling and analysis would be identified during the remedial design. Treated material meeting the Group III treatment objectives and exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8.

Site restoration. Final site restoration activities would be determined based on the requirements for the soils beneath the impoundments.

Alternative D3- off-site disposal

Alternative D3, off-site disposal, involves excavation of the category D materials and transportation off-site for disposal in a non-hazardous landfill.

Material handling. The category D material would be removed from the impoundments using standard excavation techniques, such as a long-reach excavator or backhoe. The excavations would include 6 inches of soil beneath the impoundment material. Debris would be separated from the impoundment materials, as described in Section 6.5.2 of the CMS. Excavated materials may be placed in a temporary staging area following removal.

Off-site transport and disposal. The category D material will be transported off-site by a licensed waste transporter to a non-hazardous waste landfill. Pre-treatment of the Category D material is not anticipated based on the soil-like nature of the material.

Site restoration. Final site restoration activities would be determined based on the requirements for the soils beneath the impoundments.

Alternative D4- consolidation in Impound 8

Alternative D4 involves excavation of the fill material and placement of the material in the Impound 8 facility.

Material handling. The category D material would be removed from the impoundments using standard excavation techniques, such as a long-reach excavator or backhoe. The excavations would include 6 inches of soil beneath the impoundment material. Debris would be separated from the impoundment materials, as described in Section 6.5.2 of the CMS. Excavated materials may be placed in a temporary staging area following removal.

Conditioning. Excavated material would be conditioned as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility. Conditioning would involve the addition of stabilizing agents such as Portland cement, sodium silicate, and moisture.

Final placement. Prior to placement into Impound 8, fill materials would be sampled and analyzed to confirm achievement of unconfined compressive strength requirements. The frequency of evaluation sampling and analysis would be identified during remedial design. Material exhibiting the necessary unconfined compressive strength would be transported to and placed in Impound 8, the on-site permitted, hazardous waste management facility.

Site restoration. Final site restoration activities would be determined based on the requirements for the soils beneath the impoundments.

Table 1. ***Detailed Analysis of Alternatives - Category D***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
LONG TERM EFFECTIVENESS AND PERMANENCE				
Magnitude of Residual Risk	Potential risks associated with fill constituent migration would remain.	Residual risk would be minimize by removal, conditioning as necessary, and containment in the Impound 8 facility.	Residual risk would be minimized by removal, conditioning as necessary, and containment in an off-site landfill. Inclusion of this material in an off-site hazardous material landfill would displace the future disposal of other waste materials in that landfill.	Residual risk would be minimize by fill removal, conditioning as necessary, and containment in the Impound 8 facility.
Adequacy and Reliability of Controls	Deed restrictions would have limited reliability for limiting human contact. Monitoring would be adequate and reliable for tracking impacts to ground water. Institutional actions would not control potential for constituent migration.	Removal, bioremediation, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of category D material constituents to environmental media.	Removal, conditioning, if necessary, and containment in an off-site landfill would be adequate and reliable to minimizing human exposure and minimizing migration of constituents to environmental media.	Removal, conditioning if necessary, and containment in Impound 8 would be adequate and reliable for minimizing human exposure and minimizing migration of non-hazardous fill constituents to environmental media.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT				
Treatment Process Used and Materials Treated	No treatment.	Conditioning of Impoundment 26 materials, bioremediation, and post-conditioning of category D materials. Treatment of off-gas.	Treatment of off-gas, if necessary.	Strength conditioning of fill, if necessary. Treatment of off-gas, if necessary.
Amount of Hazardous Material Destroyed or Treated	No treatment.	Conditioning, bioremediation, and post-conditioning would reduce organic constituents.	No treatment.	Conditioning of portion of material necessary to meet Impound 8 strength requirements.
Degree of Expected Reduction of Toxicity, Mobility or Volume	Institutional actions would not provide for reduction of toxicity, mobility, or volume of non-hazardous fill.	Minimization of Category D material toxicity and mobility with bioremediation and treatment residual containment in Impound 8. Approximate net volume increase expected with treatment is 200% for Impoundment 5 material and 100% for Impoundment 26 material.	Minimization of category D material mobility with containment in an off-site landfill. Potential	Minimization of fill mobility with containment in Impound 8. Potential volume increase with strength conditioning, if necessary.

Table 1. ***Detailed Analysis of Alternatives - Category D***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Degree to Which Treatment is Irreversible	No treatment.	Conditioning, bioremediation, and post-conditioning would be irreversible.	No treatment.	Conditioning, if necessary, would be irreversible.
Type and Quantity of Residuals Remaining After Treatment	No treatment.	Approximately 53,300 ton of treated, post-conditioned material. Air pollution control residuals likely consisting of solid-phase adsorbent.	Air pollution control residuals, if necessary, likely consisting of solid-phase adsorbent.	Conditioned fill material, if conditioning necessary. Air pollution control residuals, if necessary, likely consisting of solid-phase adsorbent.
SHORT-TERM EFFECTIVENESS				
Protection of Community During Remedial Actions	Community is restricted from access to Impoundments 5 and 26. Future land use would be restricted. No impacts to community from ground water monitoring.	Community is restricted from access to Impoundments 5 and 26. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of non-hazardous fill material.	Community is restricted from access to Impoundments 5 and 26. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport off-site may impact community.	Community is restricted from access to Impoundments 5 and 26. Vapor emissions/odors during materials handling and treatment would be controlled. Material transport would be limited to within site. Minimal impacts to community from Impound 8 containment of non-hazardous fill material.
Protection of Workers During Remedial Actions	Appropriate protective equipment would be utilized during monitoring activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.	Appropriate protective equipment would be utilized during remedial activities.
Environmental Impacts	Continued potential for fill material constituent migration.	Minimal environmental impacts with containment category D material in Impound 8.	Minimal environmental impacts with containment of category D material in an off-site landfill.	Minimal environmental impacts with containment fill material in Impound 8.
Time Until RAOs Are Achieved	Removal of the material from the Impoundments and minimization of migration of fill constituents to air, soil, and ground water would not be achieved with institutional actions.	RAO would be achieved upon completion of excavation of category D material which would be approximately 2 to 3 years.	RAO would be achieved upon completion of excavation of fill material, which would be approximately 1 to 2 yr.	RAO would be achieved upon completion of excavation of fill material, which would be approximately 1 to 2 yr.

Table 1. ***Detailed Analysis of Alternatives - Category D***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Ability to Construct and Operate the Technology	Monitoring would be readily implemented.	Pilot study results indicated that bioremediation is feasible. Post-conditioning and placement in Impound 8 would be readily implemented.	Conditioning, if necessary, and placement in an off-site landfill would be readily implemented.	Conditioning, if necessary, and placement in Impound 8, would be readily implemented.
Reliability of Technology	Land use restrictions, water cover maintenance, and monitoring are reliable for their intended functions.	Pilot study results indicate reliability of bioremediation for organic removal. Post-conditioning reliable to strength addition. Placement in Impound 8 reliable for long-term residual containment.	Placement in an off-site landfill reliable for long-term residual containment.	Conditioning reliable for strength addition. Placement in Impound 8 reliable for long-term residual containment.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 5 and 26 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 5 and 26 readily implemented, if necessary.	Additional remedial actions in vicinity of Impoundments 5 and 26 readily implemented, if necessary.
Ability to Monitor Effectiveness of Remedy	Ground water monitoring would indicate changes in ground water quality at the site.	Strength sampling/analysis would indicate attainment of strength requirements. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.	Permitted landfill considered to be an effective containment system.	Strength sampling/analysis would indicate attainment of strength requirements. Routine Impound 8 inspection/maintenance would indicate effectiveness of containment system.
Coordination With Other Agencies	None required.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.	Coordination with NJDEP required regarding allowable air emissions. NJDEP approval potentially required for backfill in floodplain areas.
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities, If Necessary	None required.	None required.	Off-site permitted landfill readily available.	None required.

Table 1. ***Detailed Analysis of Alternatives - Category D***

	Alternative D1 No Action/Institutional Actions	Alternative D2 Bioremediation with Final Placement in Impound 8	Alternative D3 Off-Site Disposal	Alternative D4 Consolidation into Impound 8
Availability of Necessary Equipment, Specialist and Materials	Sampling equipment, personnel, and analytical laboratories readily available.	Mixing equipment for pretreatment and post-conditioning readily available. Bioremediation equipment and specialists readily available.	Mixing equipment for conditioning, if necessary, readily available.	Mixing equipment for conditioning readily available.
Availability of Prospective Technologies	None required.	Bioremediation equipment readily available.	None required.	Conditioning technologies readily available.
COST				
Total Estimated Capital Costs	$3,600	$17,000,000	$10,000,000	$1,800,000
Estimated Annual O & M Cost	$14,000	N/A	N/A	N/A
Total Estimated Present Worth Cost (30 yr)	$170,000	$17,000,000	$10,000,000	$1,800,000
REGULATORY AGENCY ACCEPTANCE				
Regulatory agency acceptance will be documented in the ROD.				
COMMUNITY ACCEPTANCE				
Community acceptance will be documented in the ROD following public comment on the proposed plan.				

Table 2. *Alternative D2 Cost Estimate - Solid-phase Bioremediation with final placement in Impound 8*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$3,000	$3,000	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	47,400	C.Y.	$17	$805,800	
Site Preparation	1	Lump Sum	$195,000	$195,000	
Bioremdiation Unit Mob/Demob	1	Lump Sum	$150,000	$150,000	
Treatment					
Pre-treatment Conditioning	124,600	C.Y.	$14	$1,744,400	
Biological Treatment Processing	124,600	C.Y.	$30	$3,738,000	
Chemical Analysis	1	Lump Sum	$330,000	$330,000	
Biological Analysis	1	Lump Sum	$85,000	$85,000	
Post-treatment Conditioning	140,175	Ton	$16	$2,242,800	
Material Strength Testing	1,752	Sample	$85	$148,936	
Air Control	53,325	Ton	$10	$533,250	
Final Material Placement					
Transportation to Impound 8	124,600	C.Y.	$5	$623,000	
Placement into Impound 8	124,600	C.Y.	$8	$996,800	
				Subtotal	$11,621,986
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$2,905,496
Engineering (15% Direct capital cost)					$1,743,298
Administration (5% Direct capital cost)					$581,099
TOTAL CAPITAL COST					**$16,851,880**
TOTAL PRESENT WORTH COST					**$16,851,880**
ROUNDED TO					**$17,000,000**

Table 3. *Alternative D3 Cost Estimate - Off-site disposal*

Item	Quantity	Unit	Unit Costs	Subtotal Cost	Total Costs
DIRECT CAPITAL COSTS					
Site Work					
Mobilization/Demobilization	1	Lump Sum	$150,000	$1,500	
Concrete Pad and Drainage System	1	Lump Sum	$26,000	$26,000	
Excavation	47,400	C.Y.	$9	$426,600	
Transportation and Disposal					
Chemical Analysis (TCLP)	200	Sample	$750	$150,000	
Transportation to Off-Site Landfill	2,000	Truck	$325	$650,000	
Placement into Off-site Landfill	59,000	C.Y.	$100	$5,900,000	
				Subtotal	$7,154,100
INDIRECT CAPITAL COSTS					
Contingency (25% Direct capital cost)					$1,788,525
Engineering (15% Direct capital cost)					$1,073,115
Administration (5% Direct capital cost)					$357,705
TOTAL CAPITAL COST					**$10,373,445**
TOTAL PRESENT WORTH COST					**$10,373,445**
ROUNDED TO					**$10,000,000**

Notes:
1) One TCLP sample per 10 trucks will be required.
2) Material will be accepted at a landfill within 100 miles of the site.
3) Large debris will be handled as part of material category E.
4) Material will be accepted at a non-hazardous disposal facility.

Attachment 8

Revised Risk Reduction Analysis

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
September 16, 1996

Group III Impoundments -
Risk Reduction Factors Calculated Using Original Treatment Objectives (Table G-2 of April 1996 CMS/FS)

Chem Group	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}	Group III Treatment Objective (mg/kg)	RMF at Treatment Objective	RRF_{nc} at HQ = 1, at Treatment Objective	RRF_c at RT = 10^{-6}, at Treatment Objective	RRF_{max}, at Treatment Objective
VOC	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	2.94E+09	0.00E+00	3.56E+14	3.56E+14	2.00E+02	2.96E+07	0.00E+00	3.58E+12	3.58E+12
SVOC	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	2.04E+08	3.19E+12	0.00E+00	3.19E+12	5.20E+03	1.89E+08	2.95E+12	0.00E+00	2.95E+12
SVOC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00	4.36E+08	0.00E+00	8.21E+11	8.21E+11	1.43E+04	4.05E+08	0.00E+00	7.63E+11	7.63E+11
SVOC	Naphthalene	91-20-3	D		4.00E-02	2.00E+03	4.00E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11	1.32E+04	1.53E+09	9.55E+09	0.00E+00	9.55E+09
VOC	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	7.75E+08	3.80E+09	0.00E+00	3.80E+09	2.00E+02	2.68E+07	1.31E+08	0.00E+00	1.31E+08
SVOC	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	9.78E+08	1.65E+09	0.00E+00	1.65E+09	2.30E+03	2.50E+08	4.22E+08	0.00E+00	4.22E+08
SVOC	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08	5.00E+02	6.45E+07	1.49E+08	0.00E+00	1.49E+08
VOC	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	3.68E+08	7.07E+07	0.00E+00	7.07E+07	5.00E+02	7.40E+07	1.42E+07	0.00E+00	1.42E+07
										Total RRF for chemicals with treatment objectives:	3.60E+14					7.30E+12
										Percent reduction in Total RRF:						98.0%

Group III Impoundments -
Risk Reduction Factors Calculated Using Treatment Objectives for Biotreatment

Chem Group	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}	Group III Treatment Objective (mg/kg)	RMF at Treatment Objective	RRF_{nc} at HQ = 1, at Treatment Objective	RRF_c at RT = 10^{-6}, at Treatment Objective	RRF_{max}, at Treatment Objective
VOC	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	2.94E+09	0.00E+00	3.56E+14	3.56E+14	6.00E+01	8.88E+06	0.00E+00	1.07E+12	1.07E+12
SVOC	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	2.04E+08	3.19E+12	0.00E+00	3.19E+12	5.30E+03	1.89E+08	2.96E+12	0.00E+00	2.96E+12
SVOC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00	4.36E+08	0.00E+00	8.21E+11	8.21E+11	1.81E+04	4.20E+08	0.00E+00	7.92E+11	7.92E+11
SVOC	Naphthalene	91-20-3	D		4.00E-02	2.00E+03	4.00E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11	2.03E+04	2.21E+09	1.38E+10	0.00E+00	1.38E+10
VOC	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	7.75E+08	3.80E+09	0.00E+00	3.80E+09	1.45E+02	2.01E+07	9.87E+07	0.00E+00	9.87E+07
SVOC	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	9.78E+08	1.65E+09	0.00E+00	1.65E+09	1.90E+03	2.18E+08	3.68E+08	0.00E+00	3.68E+08
SVOC	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08	3.20E+02	4.37E+07	1.01E+08	0.00E+00	1.01E+08
VOC	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	3.68E+08	7.07E+07	0.00E+00	7.07E+07	2.30E+02	3.40E+07	6.55E+06	0.00E+00	6.55E+06
	Total RRF for chemicals with treatment objectives:										3.60E+14					4.83E+12
	Percent reduction in Total RRF:															98.7%

Group III Impoundments -
Risk Reduction Factors Calculated Using Treatment Objectives for LTTT

Chem Group	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}	Group III Treatment Objective (mg/kg)	RMF at Treatment Objective	RRF_{nc} at HQ = 1, at Treatment Objective	RRF_c at RT = 10^{-6}, at Treatment Objective	RRF_{max}, at Treatment Objective
VOC	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	2.94E+09	0.00E+00	3.56E+14	3.56E+14	1.00E+02	1.48E+07	0.00E+00	1.79E+12	1.79E+12
SVOC	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	2.04E+08	3.19E+12	0.00E+00	3.19E+12	1.60E+02	2.23E+07	3.48E+11	0.00E+00	3.48E+11
SVOC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00	4.36E+08	0.00E+00	8.21E+11	8.21E+11	1.43E+04	4.05E+08	0.00E+00	7.63E+11	7.63E+11
SVOC	Naphthalene	91-20-3	D		4.00E-02	2.00E+03	4.00E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11	6.71E+02	9.35E+07	5.84E+08	0.00E+00	5.84E+08
VOC	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	7.75E+08	3.80E+09	0.00E+00	3.80E+09	2.00E+02	2.68E+07	1.31E+08	0.00E+00	1.31E+08
SVOC	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	9.78E+08	1.65E+09	0.00E+00	1.65E+09	2.00E+02	2.73E+07	4.60E+07	0.00E+00	4.60E+07
SVOC	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08	2.00E+02	2.77E+07	6.40E+07	0.00E+00	6.40E+07
VOC	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	3.68E+08	7.07E+07	0.00E+00	7.07E+07	1.25E+02	1.85E+07	3.56E+06	0.00E+00	3.56E+06
									Total RRF for chemicals with treatment objectives:		3.60E+14					2.90E+12
									Percent reduction in Total RRF:							99.2%

/ file
Group III-C

State of New Jersey

Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

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Patricia Wells McDonald, Manager
Department of Environment & Safety
American Home Products Corporation
One Campus Drive
Parsippany, NJ 07054

Dear Ms. McDonald:

Re: American Cyanamid /American Home Products Site
Bridgewater Township, Somerset County

The New Jersey Department of Environmental Protection (NJDEP) and the United States Environmental Protection Agency (USEPA) have reviewed your response letter dated 30 JAN 1997 concerning the second set of comments on the Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS). A meeting was held on 15 APR 1997 between NJDEP, USEPA and American Home Products Corporation (AHPC) to further discuss responses provided in your 30 JAN 1997 letter. As such, the following comments incorporate that discussion:

GENERAL COMMENT:

Resp 1: As discussed during the 15 APR meeting, please provide the following information:

- Evaluation for all contaminants of concern (COCs) in structural functional groups as specified in Superfund Guidance 6A.
- Evaluation on an individual basis for all COCs based on mass and volume reduction before and after treatment considering total mass and volume of waste material being considered for biotreatment. Please include all calculations in this evaluation.

- Do not use maximum values; use average values (6-month time weighted average).

- Keep previously established numerical values of all COCs for comparison purposes and compliance determination.

- Include a proposal, as part of the recommended alternatives, for contingency for the Impoundment 8 Facility in the event that contaminants and/or leakage is detected below the secondary liner system.

SPECIFIC COMMENTS:

Resp 2. Not Acceptable. The Site-Wide Baseline Endangerment Assessment (BEA) was based on reasonable maximum exposure scenarios which is consistent with the New Jersey Public law P.L. 1993, c 139 (NJSA 58:10B). As such, the risk levels derived in the BEA remain unchanged. The risk level in question, 2.4×10^{-6}, is above the acceptable risk level established in New Jersey. As such, our comment is still valid.

Resp 4: Please include this response in the revised text of the CMS/FS.

Resp 14: Text provided in Attachment 1 does not include comparison among the remedial alternatives being evaluated. Please revise the text here and for all other remedial alternatives for all other material categories. This comparison must include the following: First specify whether an alternative being evaluated achieves the criterion or not; if it does then specify how and finally specify which alternative achieves the criterion best.

Resp 16: Partially not acceptable. Last 3 sentences must be revised based on the following: Since the criterion of reduction of toxicity, mobility and volume is being assessed, discussion of alternatives being permanent or not is irrelevant. Specify only whether alternatives being considered achieves reduction in toxicity, mobility or volume.

Resp 17: See # 16.

Resp 21: The proposed revision provided here is acceptable. However, a description of excavation for Impoundment 14 still needs to be provided as specified in my previous comment.

Please submit a response to the above comments within 15 calendar days after receipt of this letter.

If you have any questions, please contact me at (609) 633-0718.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Jim Hacklar, USEPA-SUPERFUND

AMERICAN HOME PRODUCTS CORPORATION
ONE CAMPUS DRIVE, PARSIPPANY, NEW JERSEY 07054, (201) 683-2000

RECEIVED
MAY 5 1997
W. McDONALD

ENVIRONMENT & SAFETY

cc A. Caracciolo
7/15/97
cc

May 2, 1997

Mr. Haiyesh Shah
Case Manager
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Federal Case Management
Division of Responsible Party Site Remediation
401 East State Street, 5th Floor West
CN 028
Trenton, New Jersey 08625-0028

Re: Group III Impoundments CMS/FS Report
Response to 04/17/97 Comments
Bound Brook, New Jersey Facility
American Cyanamid Company

Dear Mr. Shah:

This letter provides American Home Products Corporation's (AHPC) responses to the latest set of agency comments on the Group III Corrective Measures Study/Feasibility Study (CMS/FS) Report (O'Brien & Gere, April 1996) for the American Cyanamid Site in Bound Brook, New Jersey. An initial comment letter from the agencies was issued on July 15, 1996. Responses to these comments were provided in O'Brien & Gere's letter dated September 13, 1996. Subsequent comments were received in your letter dated November 25, 1996, and were further clarified in conference calls on December 12, 1996 and January 6, 1997. AHPC responded to these comments in a letter dated January 30, 1997. A meeting was held on April 15, 1997 between NJDEP, USEPA, and AHPC to further clarify the CMS/FS approach. Following a site inspection of March 25, 1997, leading to the issuance of the third agency comment letter on April 17, 1997.

The following is a summary of the individual agency comments and AHPC responses. Upon your review and approval of these responses, we are prepared to revise the CMS/FS accordingly.

GENERAL COMMENT

Resp 1: As discussed during the April 15, 1997 meeting, please provide the following information:

- Evaluation for all contaminants of concern (COCs) in structural functional groups as specified in Superfund Guidance 6A.
- Evaluation on an individual basis for all COCs based on mass and volume reduction before and after treatment considering total mass and volume of waste material being considered for biotreatment. Please include all calculations in this evaluation.

- Do not use maximum values; use average values (6-month time weighted average).

- Keep previously established numerical values for all COCs for comparison purposes and compliance determination.

- Include a proposal, as part of the recommended alternatives, for contingency for the Impoundment 8 facility in the event that contaminants and/or leakage is detected below the secondary liner system.

Response: In order to evaluate the magnitude of materials subject to biotreatment and the small proportion of regulated COCs present within that material, AHPC conducted the requested evaluations at four levels:

1. An evaluation of overall mass and removal efficiencies based on the total mass of materials to be treated

2. An evaluation of the removal efficiencies based on the structural/functional grouping analysis provided within USEPA's Superfund LDR Guide 6A

3. An evaluation of the mass reduction of individual COCs through biotreatment, to identify appropriate compounds for monitoring treatment effectiveness

4. Contingency planning for Impound 8.

Each of these evaluations is summarized below.

1. **Overall mass evaluation**. The Group III impoundment waste materials subject to biotreatment include Impoundments 4, 5, 14, 20 and 26, and comprise a total mass of 230,467,800 lbs. Of this mass, 45,189,391 lbs (19.6%) consist of regulated compounds based on sampling and analytical data. The recommended treatment technology, biotreatment, will reduce the mass of regulated compounds to 3,245,266 lbs, or 1.4% of the total mass. This corresponds to an overall reduction efficiency of 93%. The following table summarizes this evaluation:

Impoundment	Total Mass (lbs)	Mass of Regulated Compounds (lbs)	Total Mass of Regulated Compounds after Biotreatment (lbs)
4	1,963,800	60,586	4,351
5	163,650,000	44,193,028	3,173,712
14	8,728,000	645,217	46,336
20	16,528,000	263,689	18,937
26	39,600,000	26,871	1,930
Total	230,467,800	45,189,391	3,245,266
Percent		19.6%	1.4%

2. **Structural/functional grouping analysis.** AHPC has segregated all regulated compounds of concern into structural/functional groups per USEPA's Superfund LDR Guide 6A. The evaluation procedure is consistent with that performed as part of the April 1996 CMS/FS and involved the following steps:

- Identify RCRA waste codes and Best Demonstrated Available Technology (BDAT) constituents for the RCRA waste codes present at the site. Also included are constituents listed in the March 1992 Baseline Endangerment Assessment.

- Divide the BDAT constituents into structural/functional groups shown in column 1 of Highlight 2 from the guidance.

- Compare the untreated concentration of each constituent with the threshold concentration (column 3 of Highlight 2) and select the appropriate concentration or percent reduction range.

- Summarize the structural/functional results by summing the results of the regulated COCs in each grouping to obtain each group's overall removal efficiency.

Attachment A presents the complete analysis. The following table summarizes the findings in the structural/functional groups:

Structural/ Functional Group	Feed Treatability Data (mg/Kg)	6A Variance Percent Reduction Range	Treatment Level (1) (mg/Kg)	Percent Reduction
Non-polar Aromatics	21,000	90 - 100	54	99.7%
Halogenated Non-polar Aromatics	4,860	90 - 99.9	1,570	67.7%
Halogenated Phenols	18,200	90 - 99	1,315	92.8%
Halogenated Aliphatics	21,840	95 - 99.9	394	98.2%
Halogenated Cyclics	9,200	90 - 99.9	905	90.2%
Nitrated Aromatics	41,300	99.9 - 99.99	4,630	88.8%
Polynuclear Aromatics	266,270	95 - 99	17,315	93.5%
Other Polar Organics	57,350	90 - 99	14,040	75.5%

(1) Includes the average compliance monitoring criteria for 8 prevalent COCs

As can be seen from the above, biotreatment achieves percent reductions that are within the acceptable 6A ranges for four of the eight structural/functional groups. Greater than 90% removal is realized for the structural/functional groups which represent over 95% of the regulated compounds in the waste material. Of those four structural/functional groups which do not meet the 6A ranges, one of the percent reductions is over 90% and the remainder are over 75% of their target values. This further supports biotreatment as the appropriate treatment technology for this material, given its treatment effectiveness for the regulated compounds.

3. **Evaluation of Compliance Monitoring Compounds.** The following table presents an evaluation, on an individual basis, for the eight compounds of concern for which compliance monitoring levels were previously established. These compounds were identified for compliance monitoring in the April 1996 CMS/FS as they comprise greater than 96% of the total mass of regulated compounds within the Group III impoundments. The remaining regulated compounds each comprise less than 0.5% of the total mass. This evaluation considers mass and volume reduction of the contaminants based on the total mass of the waste material being considered for biotreatment (Impoundments 4, 5, 14, 20 and 26). Attachment B presents a sample calculation regarding the mass and volume evaluation for benzene.

Compound of Concern	Total Mass Before Biotreatment (lbs)	Percent of Waste Material	Total Mass After Biotreatment (lbs)	Percent of Waste Material	Average(1) Compliance Monitoring Objective (mg/kg)
Benzene	257,901	0.11%	663	<0.01%	54
Toluene	505,878	0.22%	23,662	0.01%	145
Xylene (Total)	460,571	0.20%	15,073	<0.01%	180
Naphthalene	39,516,516	17.15%	1,975,826	0.94%	12,000
Nitrobenzene	336,361	0.14%	132,961	0.09%	3,360
1,2 Dichlorobenzene	253,235	0.11%	42,206	0.02%	250
N-Nitrosodiphenylamine	691,676	0.30%	395,243	0.20%	12,000
2-Methylnapthalene	1,526,957	0.66%	292,113	0.14%	1,760
Totals	43,549,095	18.9%	2,877,747	1.3%	

(1) Based on 6 month average concentration.

4. **Impound 8 Contingencies.** The revised CMS/FS will include a description of the contingency plan proposed in the event that contaminants and/or leakage is detected below the secondary liner system of Impound 8. The components of the plan will be summarized in Section 9 of the CMS/FS. The plan will include monitoring of the subsurface drainage system, which is located beneath the tertiary liner, in the event that leachate is present within the leachate detection system at levels greater than the Action Leakage Rate specified in the regulations. The existing Impound 8 Preparedness and Prevention Plan, and Program Contingency Plan will be modified to include the proposed components. In the event that leachate is detected beneath the tertiary liner, a ground water containment/collection program will be implemented. This program could include installation of a ground water extraction well at the Impound 8 Facility, increased pumping of the site control wells, or other

suitable method as appropriate.

SPECIFIC COMMENTS:

Resp 2: Not Acceptable. The Site-Wide Baseline Endangerment Assessment (BEA) was based on reasonable maximum exposure scenarios which is consistent with the New Jersey Public Law P.L. 1993, c 139 (NJSA 58:10B). As such, the risk levels derived in the BEA remain unchanged. The risk level in question, 2.4x10-6, is above the acceptable risk level established in New Jersey. As such, our comment is still valid.

Response: AHPC still contends that the BEA was based on conservative assumptions and if reasonable scenarios were used, the risk would be less than 1×10^{-6}. However, in order to resolve this issue, AHPC will comply with NJDEP's request and revise this statement accordingly.

Resp 4: Please include this response in the revised text of the CMS/FS.

Response: The CMS/FS will be revised accordingly.

Resp 14: Text provided in Attachment 1 does not include comparison among the remedial alternatives being evaluated. Please revise the text here and for all other remedial alternatives for all other material categories. This comparison must include the following: First specify whether an alternative being evaluated achieves the criterion or not; if it does then specify how and finally specify which alternative achieves the criterion best.

Response: The comparative analyses will be expanded to specify if the alternative achieves the criterion, how it achieves it, and the identification of which alternative achieves the criterion the best.

Resp 16: Partially not acceptable. Last 3 sentences must be revised based on the following: Since the criterion of reduction of toxicity, mobility and volume is being assessed, discussion of alternatives being permanent or not is irrelevant. Specify only whether alternatives being considered achieve reduction in toxicity, mobility or volume.

Response: The last 3 sentences will be moved from this criteria category to the "Long-term Effectiveness and Permanence" criteria category described within the CMS/FS.

Resp 17: See # 16.

Response: See response above.

Resp 21: The proposed revision provided here is acceptable. However, a description of excavation for Impoundment 14 still needs to be provided as specified in my previous comment.

Response: A sentence will be added as follows: Excavation for Impoundment 14 was accomplished by a long-reach excavator.

AHPC hopes that the clarifications provided within these responses will assist in the resolution of outstanding issues, and finalization and approval of the Group III Impoundments CMS/FS report. Should you have any questions, please call me or Tom Donohue at your convenience.

Sincerely,

Patricia W. McDonald

Patricia W. McDonald
Manager
Environmental Affairs

GAA:ndl
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Attachment

cc: Mr. James Hacklar, United States Environmental Protection Agency

bcc: A. Nadai

Attachment A

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Treatment Level	Average (2,3) Percent Reduction
NON-POLAR AROMATICS				
Total:	**21,000**	**90 - 100**	**54**	**99.7%**
benzene	*21,000*	*90 - 99.9*	*54*	*99.7%*
HALOGENATED NON-POLAR AROMATICS				
Total:	**4,860**	**90 - 99.9**	**1570**	**67.7%**
1,4-dichlorobenzene	< 960	90 - 99.9	170	82.3%
hexachlorobenzene	< 1,200	90 - 99.9	100	91.7%
1,2,4-trichlorobenzene	2,700	90 - 99.9	1300	51.9%
HALOGENATED PHENOLS				
Total:	**18,200**	**90 - 99**	**1315**	**92.8%**
4-chloroaniline	< 1,200	90 - 99	115	90.4%
2-chlorophenol	< 1,200	90 - 99	200	83.3%
4-chloro-3-methylphenol	< 1,200	90 - 99	200	83.3%
2,4-dichlorophenol	< 1,200	90 - 99	200	83.3%
pentachlorophenol	< 6,100	90 - 99	200	96.7%
2,4,5-trichlorophenol	< 6,100	90 - 99	200	96.7%
2,4,6-trichlorophenol	< 1,200	90 - 99	200	83.3%
HALOGENATED ALIPHATICS				
Total:	**21,840**	**95 - 99.9**	**394**	**98.2%**
bromodichloromethane	< 790	95 - 99.9	5	99.4%
bromoform	< 790	95 - 99.9	3	99.6%
bromomethane	< 1,500	95 - 99.9	5	99.7%
carbon tetrachloride	< 790	95 - 99.9	5	99.4%
chloroethane	< 1,500	95 - 99.9	5	99.7%
chloroform	800	95 - 99.9	15	98.1%
chloromethane	< 1,500	95 - 99.9	5	99.7%
dibromochloromethane	< 790	95 - 99.9	1	99.9%
1,1-dichloroethane	< 790	95 - 99.9	5	99.4%
1,2-dichloroethane	< 790	95 - 99.9	5	99.4%
1,1-dichloroethylene	< 790	95 - 99.9	5	99.4%
1,2-dichloropropane	< 790	95 - 99.9	5	99.4%
cis-1,3-dichloropropene	< 790	95 - 99.9	5	99.4%
trans-1,3-dichloropropene	< 790	95 - 99.9	3	99.6%
hexachlorobutadiene	< 1,200	95 - 99.9	100	91.7%
hexachloroethane	< 1,200	95 - 99.9	165	86.3%
methylene chloride	< 790	95 - 99.9	5	99.4%
1,1,2,2-tetrachloroethane	< 790	95 - 99.9	2	99.7%
tetrachloroethylene	< 790	95 - 99.9	25	96.8%
1,1,1-trichloroethane	< 790	95 - 99.9	5	99.4%
1,1,2-trichloroethane	< 790	95 - 99.9	5	99.4%
trichloroethylene	< 790	95 - 99.9	5	99.4%
vinyl chloride	< 1,500	95 - 99.9	10	99.3%

AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Treatment Level	Average (2,3) Percent Reduction
HALOGENATED CYCLICS				
Total:	**9,200**	**90 - 99.9**	**905**	**90.2%**
1,2-dichlorobenzene	*1,500*	*90 - 99.9*	*250*	*83.3%*
chlorobenzene	4,100	90 - 99.9	200	95.1%
2-chloronaphthalene	< 1,200	90 - 99.9	200	83.3%
1,3-dichlorobenzene	< 1,200	90 - 99.9	70	94.2%
hexachlorocyclopentadiene	< 1,200	90 - 99.9	185	84.6%
NITRATED AROMATICS				
Total:	**41,300**	**99.9 - 99.99**	**4630**	**88.8%**
nitrobenzene	*8,500*	*99.9 - 99.99*	*3360*	*60.5%*
4,6-dinitro-o-cresol	< 6,100	99.9 - 99.99	200	96.7%
2,4-dinitrotoluene	< 1,200	99.9 - 99.99	200	83.3%
2,6-dinitrotoluene	< 1,200	99.9 - 99.99	125	89.6%
2-nitroaniline	< 6,100	99.9 - 99.99	125	98.0%
3-nitroaniline	< 6,100	99.9 - 99.99	135	97.8%
4-nitroaniline	< 4,800	99.9 - 99.99	85	98.2%
2-nitrophenol	< 1,200	99.9 - 99.99	200	83.3%
4-nitrophenol	< 6,100	99.9 - 99.99	200	96.7%
POLYNUCLEAR AROMATICS				
Total:	**266,270**	**95 - 99**	**17,315**	**93.5%**
naphthalene	*240,000*	*95 - 99*	*12,000*	*95.0%*
2-methylnaphthalene	*9,200*	*95 - 99*	*1760*	*80.9%*
acenaphthene	1,200	95 - 99	380	68.3%
anthracene	560	95 - 99	210	62.5%
benzo(a)anthracene	490	95 - 99	1000	N/A
benzo(a)pyrene	< 1,200	95 - 99	75	93.8%
benzo(b)fluoranthene	< 1,200	95 - 99	65	94.6%
benzo(g,h,i)perylene	< 1,200	95 - 99	60	95.0%
benzo(k)fluoranthene	< 1,200	95 - 99	125	89.6%
chrysene	< 1,200	95 - 99	75	93.8%
dibenzo(a,h)anthracene	< 1,200	95 - 99	85	92.9%
fluoranthene	< 960	95 - 99	200	79.2%
fluorene	3,200	95 - 99	650	79.7%
indeno(1,2,3-cd)pyrene	< 1,200	95 - 99	40	96.7%
phenathrene	1,300	95 - 99	390	70.0%
pyrene	< 960	95 - 99	200	79.2%

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS - Response to Agency Comments
May 2, 1997

Sample Calculation for Determining Compound Mass

Step 1: Record the compound concentration of the untreated impoundment material from each impoundment subject to biotreatment. Analytical data from the 1995 pilot programs was used.

Step 2: Calculate the impoundment volumes based on previous Impoundment Characterization Program evaluations

Step 3: Record the impoundment material density based on previous Impoundment Characterization Program evaluations.

Step 4: Calculate the total mass of waste material by multiplying the impoundment volumes by the impoundment densities and summing.

Step 5: Calculate the compound mass in each impoundment by multiplying the concentration by the volume and density, making unit conversions as necessary.

Step 6: Sum the compound masses for all of the impoundments subject to biotreatment.

Step 7: Calculate the compound weight percent in the total material by dividing the compound mass by the total mass.

Impoundment	Benzene (mg/Kg)	Impoundment Volume (cy)	Impoundment Density (lb/cy)	Total Mass (lb)	Benzene Mass (lbs)
4	21,000	900	2,182	1,963,800	41,240
5	780	75,000	2,182	163,650,000	127,647
14	350	4,000	2,182	8,728,000	3,055
20	5,200	7,800	2,119	16,528,200	85,947
26	<1	17,600	2,250	39,600,000	32
Total		105,300	2,189 (Wtd Avg)	230,470,000	257,901

Benzene weight % in total material: 0.11%

RECEIVED *file Group III*

P.W. McDONALD

State of New Jersey

Christine Todd Whitman
Governor

Department of Environmental Protection

Robert C. Shinn, Jr.
Commissioner

JUN 03 1997

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
NO. Z288 500 985

Ms. Patricia Wells McDonald, Manager
Department of Environment & Safety
American Home Products Corporation
One Campus Drive
Parsippany, NJ 07054

Dear Ms. McDonald:

Re: American Cyanamid /American Home Products Site
Bridgewater Township, Somerset County

The New Jersey Department of Environmental Protection (NJDEP) and the United States Environmental Protection Agency (USEPA) have reviewed your response letter dated 2 MAY 1997 concerning the Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS). Your response letter is acceptable provided the following comments are incorporated into the CMS/FS:

1. General: Biotreatment process must be enhanced to better capture and control the volatile and semi-volatile organic compounds during excavation, handling, conditioning, pre-treatment and treatment phases of the material of the impoundments.

2. General Response 1:

- Numerical Treatment Objectives: In addition to the 6-month average values for the contaminants of concern (COCs), the maximum biotreatment values American Home Products Corporation (AHPC) has previously proposed must be achieved. The attainment of the maximum values (which must be considered as daily maximums) would minimize the potential for significantly fluctuating post-treatment levels which could conceivably attain 6-month average. Therefore, the biotreatment objectives must be as follows:

CONTAMINANT	6-MONTH AVERAGE (MG/KG)	MAXIMUM VALUE (MG/KG)
Benzene	54	60
Toluene	145	145
Xylene (total)	180	230
Naphthalene	12,000	13,100
Nitrobenzene	3,360	5,200
1,2-dichlorobenzene	250	320
N-nitrosodiphenylamine	12,000	14,300
2-methylnaphthalene	1,760	1,900

- Impoundment 8 Contingency: Your proposed contingency must be revised to provide a specific commitment that if Impoundment 8 facility's containment system fails then the AHPC will install recovery well(s) and extract contamination from those well(s).

- AHPC's Biotreatment Evaluation: The following clarification is needed:

* Page 2 of your response letter indicates that 45,189,391 pounds of a total of 230,467,800 pounds of impoundment material consist of regulated compounds. Provide a general description of the composition of the remaining material.

* The supporting calculations for the per impoundment total mass and the mass of regulated compounds before and after biotreatment (i.e., the supporting calculations for the Table on Page 3 of your letter) must be provided.

* The second sentence in the last paragraph on Page 4 must be justified since it is unclear how the structural functional groups which will attain at least 90 percent removal represent 95 percent of the regulated compounds in the waste material.

* The supporting calculations for determining the total mass of each compound of concern after biotreatment (i.e., the supporting calculations for the Table on Page 5) must be provided.

3. Specific Responses 16 and 17:

- Not acceptable. In response to our comment, you have proposed to move the last three sentences of this section to "Long-term effectiveness and Permanence section. Do not move these sentences, instead as we previously commented, delete these sentences. Stabilization and consolidation of waste material into Impoundment 8 Facility is not considered permanent.

Please submit the revised CMS/FS report incorporating the above comments and all of our previous comments within 45 calendar days upon receipt of this letter.

If you have any questions, please contact me at (609) 633-0718.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Mr. Jim Hacklar, USEPA-SUPERFUND

CC: GAA
SJR
JKW

File: 5772.013-TASK 6#

AMERICAN HOME PRODUCTS CORPORATION

ONE CAMPUS DRIVE, PARSIPPANY, NEW JERSEY 07054, (201) 683-2000

July 21, 1997

ENVIRONMENT & SAFETY

RECEIVED
JUL 23 1997
O'B & G
EDISON

Mr. Haiyesh Shah, Case Manager
New Jersey Department of Environmental Protection
Bureau of Federal Case Management
Division of Responsible Party Site Remediation
401 East State Street, 5th Floor West
CN 028
Trenton, New Jersey 08625-0028

Dear Mr. Shah:

Re: Group III Impoundments
Draft Revised Group III CMS/FS
Bound Brook, New Jersey Facility
American Cyanamid Company

Please find enclosed one copy of the revised draft Group III CMS/FS which incorporates the agency comments through the June 3, 1997, comment letter. The revised draft document contains text, tables, figures and appendices as they have been revised, in a redline and strikeout format. The revised text pages of Appendices A and B are included behind the flysheets referencing these documents. The revised risk analysis, based on the revised treatment objectives, is also included in this document as Exhibit H. The other exhibits have not been included in this draft as they have not changed. However, please note that an additional exhibit has been added in the table of contents for inclusion of the agency comment letters and AHPC response letters.

During your review of the document, you may refer to the attached table to simplify the review process. We developed the table to document the progression of comments and responses provided by the agencies within the original comment letter (July 1996) and subsequent comment letters (November 1996, April 1997 and June 1997). Where the comments are addresssed in the report, a hand-written reference is provided in the page margin based on the date of the original (and subsequent, if applicalbe) comment letter.

Certain comments have not been incorporated into the draft revised CMS/FS because no changes were necessary. These comments are noted as such in the attached table and are discussed below.

- Agency Comment 7/96 #14: The UTS and LDR have not been designated as chemical-specific ARARs in Section 3 based on our response to this comment.
- Agency Comment 7/96 #34: The agencies requested a percent removal column be added to the final treatment levels table. Based on the May 2, 1997, response, O'Brien & Gere has included the percent removal comparisons in the structural/functional grouping analysis for a better representation of the treatment efficiency achieved.
- Agency Comments 7/96 #41, 42, 83, 84, 85, 86. 87, 89: The issues raised in these comments will be addressed as part of the remedial design.
- Agency Comment 7/96 #71: No response was indicated as necessary in the September 13, 1996, response letter.
- Agency Comment 7/96 #78: No response necessary based on deletion of Section 9.4.2 per comment #77.
- Agency Comment 6/97 #1: Regarding the need for vapor control on the biotreatment system, the original text in Section 6 already discusses that vapor control will be provided in each component of the bioremediation alternative. Therefore, no additional revisions have been made in the document to address this comment.

Upon your review of this material, please call me to discuss the submission of the final revised document.

Sincerely,

Patricia W. McDonald

Patricia W. McDonald
Manager
Environmental Affairs

PWW:gaa:cc
I:\mcdonald\grp3imlr.doc

cc: Mr. Jim Hacklar, USEPA, Region 2 (two copies)
Thomas Donohue, AHPC

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS
April 1996 CMS/FS Comment Summary Table

Original Comment Letter	Subsequent Correspondence Regarding Original Comments		
7/15/96 Comment Letter Comment #	11/25/96 Comment Letter Comment #	4/17/97 Comment Letter Comment #	6/3/97 Comment Letter Comment #
1	-	-	-
2	-	-	-
3	-	-	-
4	-	-	-
5	1	-	-
6	-	-	-
7	2	Resp 2	-
8	3	-	-
9	4	Resp 4	-
10	-	-	-
11	-	-	-
12	-	-	-
13	-	-	-
14*	-	-	-
15	-	-	-
16	-	-	-
17	-	-	-
18	-	-	-
19	5	-	-
20	-	-	-
21	-	-	-
22	6	-	-
23	7	-	-
24	-	-	-
25	-	-	-
26	8, 9	-	-
27	9	-	-
28	10	-	-
29	-	-	-
30	11	-	-
31	12	-	-
32	-	-	-
33	12	-	-
34*	-	-	-
35	-	-	-
36	-	-	-
37	12	-	-
38	-	-	-
39	13	-	-
40	-	-	-
41*	-	-	-
42*	-	-	-
43	-	-	-
44	14	Resp 14	-
45	-	-	-
46	-	-	-
47	-	-	-
48	-	-	-

American Home Products Corporation
Bound Brook Remedial Program
Group III CMS/FS
April 1996 CMS/FS Comment Summary Table

Original Comment Letter	Subsequent Correspondence Regarding Original Comments		
7/15/96 Comment Letter Comment #	11/25/96 Comment Letter Comment #	4/17/97 Comment Letter Comment #	6/3/97 Comment Letter Comment #
49	-	-	-
50	-	-	-
51	-	-	-
52	-	-	-
53	-	-	-
54	-	-	-
55	-	-	-
56	-	-	-
57	-	-	-
58	15	-	-
59	16	Resp 16	3
60	-	-	-
61	-	-	-
62	-	-	-
63	-	-	-
64	17	Resp 17	3
65	-	-	-
66	-	-	-
67	18	-	-
68	-	-	-
69	-	-	-
70	-	-	-
71*	-	-	-
72	-	-	-
73	19	-	-
74	-	-	-
75	-	-	-
76	20	-	-
77	-	-	-
78*	-	-	-
79	-	-	-
80	-	-	-
81	-	-	-
82	-	-	-
83*	-	-	-
84*	-	-	-
85*	-	-	-
86*	-	-	-
87*	21	Resp 21	-
88	-	-	-
89*	-	-	-
-	General Comment 1	General Comment Resp 1	2
-	-	-	1*

Notes:
1. "-" indicates that comment response by AHPC was accepted and is not further referenced in subsequent correspondence. Original comment and response are addressed in revised CMS/FS as redline/strikeout.
2. "*" indicates that comment response by AHPC was accepted with no revision to CMS/FS necessary.

EXHIBIT H
RISK RANKING EVALUATION
FOR CHEMICALS OF POTENTIAL CONCERN
IN THE GROUP III IMPOUNDMENTS

Prepared for

American Home Products Corporation

Prepared by

ENVIRON Corporation
Princeton, NJ

July 18, 1997

EXHIBIT H

Risk Ranking Evaluation for Chemicals of Potential Concern in the Group III Impoundments

1. Objectives

This Exhibit describes the risk ranking evaluation that was performed to assist in identifying the primary compounds of concern in the Group III Impoundments, and to support the development of treatment objectives. The specific objectives of this evaluation are as follows:

- Identify the chemicals which pose the greatest relative risk (based on toxicity, mobility, and volume) in the Group III impoundments
- Based on the risk ranking, and the prevalence of the constituents across the various impoundments, identify appropriate "indicator" chemicals for evaluating treatment system performance
- Support the development of treatment objectives, based on an analysis of a reduction in relative risk (i.e., toxicity, mobility, volume)

In this analysis, the potential risk posed by chemicals in the Group III Impoundment wastes after remediation is expected to be negligible because the wastes will be deposited in the lined and capped Impound 8 facility, with very limited potential for exposure. Despite the very low likelihood of exposure to constituents in the impoundment wastes after disposal in Impound 8, the terms "potential risk" and "inherent hazard" are used interchangeably throughout this Exhibit.

2. Approach

The first step of this evaluation was to rank the Group III organic chemicals relative to inherent hazard, based on toxicity, mobility, and volume. This objective was met by calculating relative risk factor (RRF) values for the organic compounds detected in the Group III Impoundments. The methodology used for developing the RRF equation is provided in Attachment 1 to this exhibit. In summary, the exposure equations used to evaluate the potential risk posed by ingestion exposure to the chemicals leaching to ground water were simplified to include only the chemical-specific parameters. In this way, the RRF values reflect the relative hazard posed by the individual waste constituents, and account for the toxicity, mobility, and volume of each chemical. As shown in Attachment 1, for chemicals with carcinogenic effects, the RRF is calculated as:

$$RRF_c = RMF \times SF_{oral} \; / \; (K_d \times 10^{-6})$$

For chemicals with noncarcinogenic effects, the RRF is calculated as:

$$RRF_{nc} = RMF \; / \; (RfD_{oral} \times K_d \times 1)$$

A detailed explanation of the calculation of the RRF values, including definitions for RMF, SF_{oral}, RfD_{oral}, and K_d, is provided in Attachment 1.

For chemicals with both carcinogenic and noncarcinogenic effects, both RRF_c and RRF_{nc} values were calculated. The RRF_c and RRF_{nc} values were then compared, and the maximum of the two values was used as the RRF (i.e., RRF_{max}) for the chemical. If a chemical has only one effect (e.g., carcinogenic), the RRF for the other effect (in this case, noncarcinogenic) was entered as zero. The RRF_{max} values were then sorted in decreasing order (i.e., from the chemical with the highest relative risk to the chemical with the lowest relative risk) for further evaluation.

3. Identification of Risk-Based Indicator Chemicals

Results of the risk ranking, including the parameters used in the RRF calculation for each chemical, are provided in Table H-1. As shown on Table H-1, of the constituents detected in the Group III Impoundment waste, benzene represents the highest relative risk. Specifically, the RRF_{max} for benzene is an order of magnitude higher than the RRF_{max} for the next chemical on the list. The five chemicals with the highest RRF_{max} values are (in descending order):

- Benzene
- 4-Nitroaniline
- Nitrobenzene
- Chloroform
- N-Nitrosodiphenylamine

A sensitivity analysis on the RRF_{max} calculations was also performed. In the sensitivity analysis, the K_d term was excluded from the calculation to correspond to a hypothetical direct contact pathway, rather than the leaching to ground water pathway. If the K_d term is excluded from the RRF calculation, benzene is still the chemical with the highest RRF_{max} value. Therefore, benzene represents a majority of the overall inherent hazard of the Group III Impoundment chemicals for both the leaching to ground water and direct contact exposure pathways.

Based on the leaching to ground water RRF values, benzene represents about 94% of the overall inherent hazard of all chemicals in Group III Impoundments, and approximately 95% of the overall cancer hazard of all chemicals in the Group III Impoundments. The most highly ranked noncarcinogen is nitrobenzene, which represents about 90% of the overall noncancer hazard of all chemicals in the Group III Impoundments. Thus, achieving significant reductions in the mass of benzene and nitrobenzene will result in the most significant reduction in the potential cancer and noncancer hazard of the Group III Impoundment wastes.

Of the remaining chemicals within the top five, 4-nitroaniline has the highest RRF_{max} value, based largely on its mobility and its classification as a potential carcinogen. However, 4-nitroaniline is less suitable as an indicator chemical than either benzene or nitrobenzene because it is much less prevalent in the Group III Impoundment wastes. As shown in Table H-1, benzene has been detected in each of Impoundments 1, 2, 3, 4, 5, 14, and 20, which represent 100% of the total volume of the Group III Impoundment wastes to be treated, and nitrobenzene has been detected in Impoundments 1, 2, 3, 5, and 14, which represents about 95% of the total volume. By comparison, 4-nitroaniline has been detected in only one impoundment (Impoundment 5), which represents approximately 50% of the total volume. Furthermore, 4-nitroaniline is classified by USEPA as a Group C carcinogen (possible human carcinogen, based on no human data and limited data in animals[1]), whereas benzene is classified by USEPA as a Group A carcinogen (human carcinogen). When 4-nitroaniline is evaluated as a noncarcinogen only, it ranks lower than the other four chemicals on the list above (i.e., it does not rank as one of the five chemicals with the highest RRF_{max} values). Therefore, 4-nitroaniline is less appropriate as an indicator chemical than either benzene or nitrobenzene.

Both of the remaining two chemicals within the top five based on the RRF_{max} values (chloroform and n-nitrosodiphenylamine) received lower RRF scores than either benzene or nitrobenzene, and are also less prevalent in the Group III Impoundment wastes than either benzene or nitrobenzene. Chloroform and n-nitrosodiphenylamine are thus also less appropriate indicator chemicals from the perspective of risk reduction.

The selection of indicator chemicals for monitoring treatment system performance is described in Section 5 of the CMS/FS. The indicator chemicals selected in Section 5 include benzene and nitrobenzene.

4. Treatment Objectives

As discussed above, a reduction in the mass of benzene would lead to the greatest reduction in overall inherent hazard (i.e., toxicity, mobility, volume). Based on the data presented in Table H-1, reducing the benzene concentration to 2,000 mg/kg across all impoundments would reduce the overall inherent hazard of the Group III Impoundment wastes by approximately 90%. If the benzene concentration is reduced to 200 mg/kg across all Group III Impoundments, the reduction in the overall inherent hazard of Group III Impoundment wastes would approach 99%, given anticipated corresponding reductions for other waste constituents based on the O'Brien & Gere treatability studies. Thus, a treatment objective for benzene in the range of 2,000 mg/kg to 200 mg/kg would correspond to a reduction of 90% to 99% in the overall inherent hazard of the Group III Impoundment wastes.

Based on the treatability study results, treatment objectives of 54 mg/kg (6-month average) and 60 mg/kg (maximum value) have been established for benzene (see Section 5 of the CMS/FS). Treatment objectives based on the treatability studies have also been selected for the most prevalent constituents detected in the Group III Impoundment wastes (nitrobenzene, n-nitrosodiphenylamine, naphthalene, toluene, 2-methylnaphthalene, 1,2-dichlorobenzene, and xylenes). The "maximum value" treatment objectives for these compounds are presented in Table H-2. As shown in Table H-2, meeting the "maximum value" treatment objectives for benzene and the other prevalent compounds corresponds to a 99% reduction in the overall inherent hazard of the Group III Impoundment wastes. Potential risk reductions from treatment of the Group III Impoundment wastes to the "6-month average" concentrations,

---

[1] USEPA, NCEA. *Draft Risk Assessment Issue Paper for Derivation of a Provisional Oral RfD, Slope Factor, and Unit Risk for 3-Nitroaniline and 4-Nitroaniline.* August 20, 1993.

which are lower than the "maximum value" concentrations, also correspond to a 99% reduction in the overall inherent hazard of the Group III Impoundment wastes (primarily because the greatest potential risk reduction is associated with benzene, and the post-treatment "maximum value" and "6-month average" benzene concentrations differ by only 10%).

Table H-1
Group III Impoundments - Risk Ranking Factor Calculations

Chem Group	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Impound 1 Max. Conc. (mg/kg)	Impound 2 Max. Conc. (mg/kg)	Impound 3 Max. Conc. (mg/kg)	Impound 4 Max. Conc. (mg/kg)	Impound 5 Max. Conc. (mg/kg)	Impound 14 Max. Conc. (mg/kg)	Impound 20 Max. Conc. (mg/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}
Relative density ratio:								1	1	1	1	1	1	1				
Volume of impoundment (cubic yards):								1.95E+04	2.40E+04	1.68E+04	9.00E+02	7.50E+04	4.00E+03	7.80E+03	1.48E+05	= *total volume (cubic yards)*		
VOC	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	3.87E+04	6.10E+04	3.60E+04	2.10E+04	7.80E+02	3.50E+02	5.20E+03	2.94E+09	0.00E+00	3.56E+14	3.56E+14
SVOC	4-Nitroaniline	100-01-6	C	3.80E-02	3.00E-03	1.20E+01	2.40E-02					1.40E+02			1.05E+07	1.46E+11	1.66E+13	1.66E+13
SVOC	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	3.65E+02	1.33E+03	5.30E+02		1.60E+03	9.00E+03		2.04E+08	3.19E+12	0.00E+00	3.19E+12
VOC	Chloroform	67-66-3	B2	6.10E-03	1.00E-02	7.70E+01	1.54E-01	1.26E+00				8.00E+02			6.00E+07	3.90E+10	2.38E+12	2.38E+12
SVOC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00			1.50E+02		4.60E+03	2.20E+04	1.70E+01	4.36E+08	0.00E+00	8.21E+11	8.21E+11
SVOC	1,4-Dichlorobenzene	106-46-7	C	2.40E-02		2.30E+03	4.60E+00	3.86E+01	5.88E+02	1.20E+03		2.00E+02		4.40E+00	5.01E+07	0.00E+00	2.61E+11	2.61E+11
SVOC	Naphthalene	91-20-3	D		4.00E-02	2.00E+03	4.00E+00	1.39E+03	9.86E+03	2.40E+04		2.40E+05	3.60E+04	3.70E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11
SVOC	3-Nitroaniline	99-09-2	C	3.80E-02	3.00E-04	1.82E+01	3.64E-02							3.80E+00	2.96E+04	2.71E+09	3.09E+10	3.09E+10
SVOC	Benzo(a)anthracene	56-55-3	B2	7.30E-01		4.00E+05	8.00E+02					3.60E+02	2.70E+02		2.81E+07	0.00E+00	2.56E+10	2.56E+10
VOC	Chloromethane	74-87-3	C		4.00E-03	7.80E+00	1.56E-02	5.72E+01							1.12E+06	1.79E+10	0.00E+00	1.79E+10
SVOC	Benzoic Acid	65-85-0			4.00E+00	6.00E-01	1.20E-03	3.62E+02	8.84E+02						2.83E+07	5.89E+09	0.00E+00	5.89E+09
VOC	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	1.01E+02	1.62E+04	9.10E+03	3.10E+03	3.00E+03	8.20E+02	8.60E+01	7.75E+08	3.80E+09	0.00E+00	3.80E+09
SVOC	2,4-Dinitrotoluene	121-14-2			2.00E-03	9.50E+01	1.90E-01			6.30E+01					1.06E+06	2.79E+09	0.00E+00	2.79E+09
VOC	Chlorobenzene	108-90-7			2.00E-02	6.50E+02	1.30E+00					9.60E+01	2.20E+03	4.10E+03	4.80E+07	1.85E+09	0.00E+00	1.85E+09
SVOC	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	1.69E+02	1.52E+03	1.70E+03		1.20E+04	2.40E+03		9.78E+08	1.65E+09	0.00E+00	1.65E+09
SVOC	Phenol	108-95-2	D		6.00E-01	2.90E+01	5.80E-02	3.53E+01	3.82E+01	2.40E+02		3.20E+02		6.40E+00	2.97E+07	8.53E+08	0.00E+00	8.53E+08
SVOC	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.10E+02	2.21E+03	1.10E+04		1.50E+03	1.30E+02	9.60E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08
SVOC	4-Chloroaniline	106-47-8			4.00E-03	6.60E+01	1.32E-01							2.30E+01	1.79E+05	3.40E+08	0.00E+00	3.40E+08
SVOC	Fluorene	86-73-7	D		4.00E-02	1.40E+04	2.80E+01		4.73E+02	2.80E+03		3.20E+03	3.80E+02		3.00E+08	2.68E+08	0.00E+00	2.68E+08
SVOC	2,4-Dimethylphenol	105-67-9			2.00E-02	2.10E+02	4.20E-01	1.17E+01	2.71E+01				1.10E+02		1.32E+06	1.57E+08	0.00E+00	1.57E+08
SVOC	Acenaphthene	83-32-9			6.00E-02	7.10E+03	1.42E+01	1.02E+01	3.14E+02			1.40E+03	9.40E+02		1.16E+08	1.37E+08	0.00E+00	1.37E+08
SVOC	2-Methylphenol	95-48-7	C		5.00E-02	5.40E+01	1.08E-01			4.20E+01					7.06E+05	1.31E+08	0.00E+00	1.31E+08
VOC	Ethyl Benzene	100-41-4	D		1.00E-01	1.20E+03	2.40E+00	1.14E+02			1.20E+03	1.70E+02	7.50E+01	1.00E+03	2.42E+07	1.01E+08	0.00E+00	1.01E+08
SVOC	Phenanthrene	85-01-8	D		4.00E-02	1.40E+04	2.80E+01	2.79E+01	1.84E+02	3.60E+02		1.30E+03	3.40E+02		1.10E+08	9.81E+07	0.00E+00	9.81E+07
SVOC	1,2,4-Trichlorobenzene	120-82-1	D		1.00E-02	8.80E+03	1.76E+01			7.00E+01			3.20E+03		1.40E+07	7.94E+07	0.00E+00	7.94E+07
VOC	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	1.76E+03	3.44E+03	2.30E+03	1.00E+03	2.20E+03	8.40E+02	5.50E+03	3.68E+08	7.07E+07	0.00E+00	7.07E+07
VOC	Carbon Disulfide	75-15-0			1.00E-01	9.30E+01	1.86E-01	4.44E+01							8.66E+05	4.65E+07	0.00E+00	4.65E+07
SVOC	Dimethylphthalate	131-11-3			1.00E+01	3.50E+01	7.00E-02						3.50E+03		1.40E+07	2.00E+07	0.00E+00	2.00E+07
SVOC	1,3-Dichlorobenzene	541-73-1	D		9.00E-02	1.70E+03	3.40E+00		1.15E+02	1.90E+02					5.95E+06	1.95E+07	0.00E+00	1.95E+07
SVOC	2-Chloronaphthalene	91-58-7			8.00E-02	4.80E+03	9.60E+00	1.01E+02	3.78E+02				6.00E+02		1.34E+07	1.75E+07	0.00E+00	1.75E+07
SVOC	Acenaphthylene	208-96-8	D		4.00E-02	4.90E+03	9.80E+00			3.30E+02					5.54E+06	1.41E+07	0.00E+00	1.41E+07
SVOC	Dibenzofuran	132-64-9	D		6.00E-01	7.94E+03	1.59E+01	3.58E+01	2.47E+02	1.90E+02		1.40E+03	7.80E+02		1.18E+08	1.24E+07	0.00E+00	1.24E+07
SVOC	Anthracene	120-12-7	D		3.00E-01	2.12E+04	4.24E+01					5.60E+02	1.10E+02		4.24E+07	3.33E+06	0.00E+00	3.33E+06
SVOC	Fluoranthene	206-44-0	D		4.00E-02	1.10E+05	2.20E+02	1.04E+01	3.70E+01			2.60E+02			2.06E+07	2.34E+06	0.00E+00	2.34E+06
SVOC	Pyrene	129-00-0	D		3.00E-02	1.10E+05	2.20E+02	1.16E+01		4.00E+01		1.80E+02			1.44E+07	2.18E+06	0.00E+00	2.18E+06

Notes:
1. References for the toxicity and transport values are provided in Attachment 2 to Exhibit H.
2. The relative density ratios and impoundment volumes used in this analysis represent the waste volumes to be treated (Waste Categories A, B, C). Volumes and densities for these waste categories are reported in Table 2-1 of the CMS/FS.
3. The concentration data used in this analysis represents the maximum chemical concentration reported in Table A-1 of the CMS/FS.
4. The references noted in 1-3 above are further discussed in Attachment 1 to Exhibit H.

Table H-2

Group III Impoundments -
Risk Reduction Factors Calculated Using Treatment Objectives

Chem Group	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}	Group III Treatment Objective, "maximum value" (mg/kg)	RMF at Treatment Objective	RRF_{nc} at HQ = 1, at Treatment Objective	RRF_c at RT = 10^{-6}, at Treatment Objective	RRF_{max}, at Treatment Objective
C	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	2.94E+09	0.00E+00	3.56E+14	3.56E+14	6.00E+01	8.88E+06	0.00E+00	1.07E+12	1.07E+12
OC	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	2.04E+08	3.19E+12	0.00E+00	3.19E+12	5.20E+03	1.89E+08	2.95E+12	0.00E+00	2.95E+12
OC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00	4.36E+08	0.00E+00	8.21E+11	8.21E+11	1.43E+04	4.05E+08	0.00E+00	7.63E+11	7.63E+11
OC	Naphthalene	91-20-3	D	----	4.00E-02	2.00E+03	4.00E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11	1.31E+04	1.52E+09	9.49E+09	0.00E+00	9.49E+09
C	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	7.75E+08	3.80E+09	0.00E+00	3.80E+09	1.45E+02	2.01E+07	9.87E+07	0.00E+00	9.87E+07
OC	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	9.78E+08	1.65E+09	0.00E+00	1.65E+09	1.90E+03	2.18E+08	3.68E+08	0.00E+00	3.68E+08
OC	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08	3.20E+02	4.37E+07	1.01E+08	0.00E+00	1.01E+08
C	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	3.68E+08	7.07E+07	0.00E+00	7.07E+07	2.30E+02	3.40E+07	6.55E+06	0.00E+00	6.55E+06
						Total RRF for chemicals with treatment objectives:					3.60E+14					4.80E+12
							Percent reduction in Total RRF:									99%

Note: "Group III Treatment Objectives" presented in Section 5 of the CMS/FS.

Attachment 1 to Exhibit H
Methodology for Developing the Risk Ranking Factor Equation

1. Overview
The relative risk ranking developed for this analysis takes into account the toxicity, mobility, and volume of a chemical in the Group III Impoundments. This attachment presents the technical basis for the ranking approach, and how individual parameters representing toxicity, mobility, and volume were combined into a relative risk factor (RRF) for each of the Group III chemicals of potential concern.

2. Toxicity
As discussed in the CMS/FS, hazardous wastes from the Group III Impoundments will ultimately be deposited into the Impound 8 facility, which is being constructed with an impermeable cap, a triple liner, and leachate collection systems. Ground water in the vicinity of the Impound 8 facility is also contained by an interceptor trench. Thus, the potential for exposure through any pathway will essentially be eliminated. However, for the purposes of the risk ranking, it is assumed that the pathway of greatest potential concern is ingestion of ground water as a drinking water source. For this reason, oral toxicity data was used in this evaluation to estimate the toxicity associated with the chemicals of potential concern. For potential carcinogens, oral slope factor values (SF_{oral}) from USEPA were used as a measure of carcinogenic potency; for noncarcinogens, chronic oral reference dose values (RfD_{oral}) from USEPA were used as a measure of noncancer toxicity. A summary of the SF_{oral} and RfD_{oral} values used for this evaluation is presented in Attachment 2 to Exhibit G.

3. Mobility
Since ground water is the pathway for which the RRF evaluation is performed, the appropriate measure of mobility is the soil-to-water partitioning coefficient (K_d). For organic chemicals, the K_d value is:

$$K_d = K_{oc} \times f_{oc}$$

where:

K_{oc}	=	organic carbon partitioning coefficient (L-water/kg-organic carbon)
f_{oc}	=	organic carbon weight fraction in soil (unitless), assume = 0.002 for this analysis

Since no K_{oc} or f_{oc} data is available for the Group III Impoundment wastes, USEPA-published K_{oc} and f_{oc} data for soils were used for this analysis. The selection of a specific value for f_{oc} has no impact on the results of the relative risk ranking, because it is a constant and has an equal effect on the RRF for all chemicals. A summary of the K_d values used for this evaluation is presented in Attachment 2 to Exhibit G.

4. Volume

The volume of each constituent was represented by a relative mass factor (RMF), which takes into account the volume and density of the waste in each impoundment and the concentration of each chemical in each impoundment, as follows:

$$RMF = \sum_{i,j} (C_{ij})\ (V_j)\ (D_j)$$

where:

C = concentration of chemical I in Impoundment j (mg/kg)
V = volume of waste in Impoundment j (cubic yards)
D = relative density ratio of waste in Impoundment j (unitless)

Inputs to the RMF calculation are further discussed below.

a. Concentration

The maximum detected chemical concentration for each impoundment from Table A-1 of the CMS/FS was used in this analysis. This approach for calculating the concentration term is consistent with USEPA's *Risk Assessment Guidance for Superfund, Volume I*; according to USEPA, use of the maximum detected concentration (rather than the 95% upper confidence limit on the mean) where there is a limited data set is appropriate. If a chemical was detected in a given impoundment, but not detected in a specific sample within the impoundment (i.e., concentration reported below detection limits on Table A-1), half of the chemical's detection limit was used to represent the concentration of the chemical in the given sample. However, since the maximum detected chemical concentration was used to represent the chemical concentration in the entire impoundment (rather than the 95% upper confidence limit on the mean), it was unnecessary to use the half detection limits in any of the risk ranking calculations. Consistent with USEPA's *Risk Assessment Guidance for Superfund, Volume I*, a chemical was assumed not to be present in a given impoundment if it was not detected in any sample from that impoundment.

A summary of the concentration data used for this evaluation is presented in Table H-1.

b. Volume

The volume of the impoundment wastes in Waste Categories A, B, and C were used in this evaluation. Since wastes in Waste Category D will not be treated for organics and Waste Category E will not be treated, waste volumes in these categories were subtracted from the total volume for an impoundment, if applicable. For example, the total volume of Impoundment 5 is 110,300 cubic yards. Of this, 35,300 cubic yards is in Waste Categories D and E, so the volume of Impoundment 5 used in this analysis is 75,000 cubic yards. A summary of the impoundment volumes used for this evaluation is presented in Table H-1.

c. **Relative Density Ratio**
As noted in Table 2-1 of the CMS/FS, the waste densities are relatively similar for the various impoundments; therefore, the relative density ratio used in this evaluation was set to 1 for all impoundments (i.e., there are no significant differences in waste densities across the various impoundments).

5. Calculation of Relative Risk Factor

Each of the toxicity, mobility and volume factors were combined in a relative risk factor (RRF) equation. This equation was based on the equations which are used to evaluate risks from ingestion of ground water:

$$\text{Cancer Risk} = C_{gw} \times SF_{oral} \times \text{Intake}$$

For noncancer effects:

$$\text{Hazard Quotient (HQ)} = \frac{C_{gw} \times \text{Intake}}{RfD_{oral}}$$

where:

C_{gw} = concentration of chemical in the ground water (mg/L)
Sf_{oral} = oral slope factor $(mg/kg/day)^{-1}$
RfD_{oral} = oral reference dose (mg/kg/day)
Intake = ground water intake (L/kg-day)

In the factors considered in the calculation of risk, only the concentration (C_{gw}) and toxicity factors (SF_{oral} and RfD_{oral}) are chemical-dependent; ground water intake is not chemical-dependent. Because the objective of this analysis is to rank the Group III impoundment organic chemicals *relative* to one another (i.e., not an actual calculation of risk), the intake portion of the risk evaluation can be eliminated since it would be the same for all chemicals.

For estimation of carcinogenic risk, the risk equation therefore becomes:

$$\text{Relative Cancer Risk } (RRF_c) = C_{gw} \times SF_{oral}$$

For estimation of noncarcinogenic risk, the risk equation therefore becomes:

$$\text{Relative HQ } (RRF_{nc}) = C_{gw} \;/\; RfD_{oral}$$

Since the ground water concentration is estimated as the chemical concentration in the solid (C_s) divided by the K_d, the relative risk equations become:

$$RRF_c = C_s \times SF_{oral} / K_d$$

$$RRF_{nc} = C_s / (RfD_{oral} \times K_d)$$

To account for the volume as well as the concentration of the individual constituents, the relative mass factor (RMF) is substituted for C_s. Furthermore, in order to allow for a combined ranking of both cancer and noncancer effects, a risk target of 10^{-6} was used for carcinogenic risk, and a HQ target of 1.0 was used for noncancer risk. Substituting these factors into the general risk equation results in the following:

$$RRF_c = RMF \times SF_{oral} / (K_d \times 10^{-6})$$

$$RRF_{nc} = RMF / (RfD_{oral} \times K_d \times 1)$$

RRFs calculated for this evaluation are listed in Table H-1.

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Exhibit H
Attachment 2
Toxicity and Transport Values Used in the Risk Ranking Factor Calculations

Chem Group	Constituent	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$			RfD_{oral} (mg/kg/d)			K_{oc} (L/kg)	
				Value	Notes	Ref	Value	Notes	Ref	Value	Ref
VOC	Benzene	71-43-2	A	2.90E-02	26	1		6		1.20E+02	40
VOC	Carbon Disulfide	75-15-0					1.00E-01		1	9.30E+01	40
VOC	Chlorobenzene	108-90-7					2.00E-02		1	6.50E+02	40
VOC	Chloroform	67-66-3	B2	6.10E-03		1	1.00E-02		1	7.70E+01	40
VOC	Chloromethane	74-87-3	C		14	35	4.00E-03	6	34	7.80E+00	40
VOC	Ethyl Benzene	100-41-4	D				1.00E-01		1	1.20E+03	40
VOC	Toluene	108-88-3	D				2.00E-01		1	5.10E+02	40
VOC	Xylenes (total)	1330-20-7	D				2.00E+00		1	1.30E+03	40
SVOC	1,2,4-Trichlorobenzene	120-82-1	D				1.00E-02		1	8.80E+03	40
SVOC	1,2-Dichlorobenzene	95-50-1	D				9.00E-02		1	2.40E+03	40
SVOC	1,3-Dichlorobenzene	541-73-1	D				9.00E-02	10		1.70E+03	2
SVOC	1,4-Dichlorobenzene	106-46-7	C	2.40E-02	6	2				2,30E+03	40
SVOC	2,4-Dimethylphenol	105-67-9					2.00E-02		1	2.10E+02	40
SVOC	2,4-Dinitrotoluene	121-14-2					2.00E-03		1	9.50E+01	40
SVOC	2-Chloronaphthalene	91-58-7					8.00E-02		1	4.80E+03	3
SVOC	2-Methylnaphthalene	91-57-6					4.00E-02	9,21		7.41E+03	6
SVOC	2-Methylphenol	95-48-7	C				5.00E-02		1	5.40E+01	34
SVOC	3-Nitroaniline	99-09-2	C	3.80E-02	22	44	3.00E-04		44	1.82E+01	6
SVOC	4-Chloroaniline	106-47-8					4.00E-03		1	6.60E+01	40
SVOC	4-Nitroaniline	100-01-6	C	3.80E-02	22	44	3.00E-03		44	1.20E+01	6
SVOC	Acenaphthene	83-32-9					6.00E-02		1	7.10E+03	40
SVOC	Acenaphthylene	208-96-8	D				4.00E-02	9		4.90E+03	34
SVOC	Anthracene	120-12-7	D				3.00E-01		1	2.12E+04	34
SVOC	Benzo(a)anthracene	56-55-3	B2	7.30E-01	5	10				4.00E+05	40
SVOC	Benzoic Acid	65-85-0					4.00E+00		1	6.00E-01	34
SVOC	bis(2-Ethylhexyl)phthalate	117-81-7	B2	1.40E-02		1	2.00E-02		1	1.50E+07	40
SVOC	Dibenzofuran	132-64-9	D				6.00E-01	14	4	7.94E+03	6
SVOC	Dimethylphthalate	131-11-3					1.00E+01	18	2	3.50E+01	40
SVOC	Fluoranthene	206-44-0	D				4.00E-02		1	1.10E+05	40
SVOC	Fluorene	86-73-7	D				4.00E-02		1	1.40E+04	40
SVOC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1				1.30E+03	40

Exhibit F

In-place containment study

Source: BB&L. 1995. Group III Impoundments Corrective Measure Study/Feasibility Study Report

Exhibit F is included as Volume 4

Exhibit G

Analytical Database

Source: BB&L. 1995. Group III Impoundments Corrective Measure Study/Feasibility Study Report

TABLE 2.3.1
AMERICAN CYANAMID COMPANY, BOUND BROOK, NEW JERSEY
GROUP III CMS/FS
DATABASE SUMMARY FOR CONTAMINANT CONCENTRATIONS

	Impoundment 3				Impoundment 4 (1)				Impoundment 5 (sludge) (2)				Impoundment 14				Impoundment 20 (3)				Impoundment 26			
mg/kg	Min	Max	Mean	Detects	Min	Max	Mean	Detects	Min	Max	Mean	Detects	Min	Max	Mean	Detects	Min	Max	Mean	Detects	Min	Max	Mean	Detects
Volatiles																								
methylene chloride	37.00	37.00	37.00	1 of 5	ND	11.00	3.67	1 of 3	0.52	530.00	112.52	8 of 14	ND	15.00	7.50	1 of 2	110.00	160.00	135.00	2 of 2	0.01	0.40	0.15	3 of 4
acetone					38.00	38.00	38.00	1 of 3	1.70	5,500.00	1,095.67	7 of 14									0.06	6.90	2.37	3 of 4
1,1-dichloroethene									0.59	0.59	0.59	1 of 14												
1,2-dichloroethane									110.00	110.00	110.00	1 of 14												
1,1,1-trichloroethane									0.56	0.56	0.56	1 of 14												
1,1,2-trichloroethane									0.83	0.83	0.83	1 of 14												
2-butanone					15.00	15.00	15.00	1 of 3																
4-methyl-2-pentanone					1.9J	1.9J	1.9J	1 of 3																
trans-1,2-dichloroethene									0.66	0.66	0.66	1 of 14												
benzene	44.00	1,000.00	295.80	5 of 5	2,900.00	20,000.00	12,633.33	3 of 3	25.00	82,000.00	10,070.71	9 of 14	610.00	1,300.00	955.00	2 of 2	1,600.00	5,500.00	3,633.33	3 of 3	0.04	330.00	84.95	4 of 4
carbon disulfide	7.60	7.60	7.60	1 of 5																				
chloroform	7.50	7.50	7.50	1 of 5	ND	25.00	8.30	1 of 3	19.00	26,000.00	4,090.00	7 of 14	ND	78.00	39.00	1 of 2								
tetrachloroethene					ND	7.6J	3.80	1 of 3																
toluene	15.00	370.00	149.60	5 of 5	710.00	6,100.00	3,636.67	3 of 3	69.00	35,000.00	4,761.00	9 of 14	1,200.00	1,300.00	1,250.00	2 of 2					0.02	1,400.00	484.34	3 of 4
trichloroethylene									0.83	0.83	0.83	1 of 14												
ethylbenzene	8.10	19.00	12.13	3 of 5	72.00	320.00	210.67	3 of 3	7.40	410.00	119.05	8 of 14	ND	120	60	1 of 2	220.00	680.00	400.00	3 of 3	0.004	270.00	91.00	3 of 4
chlorobenzene	9.60	13.00	11.30	2 of 5	28.00	130.00	92.67	3 of 3	9.00	440.00	134.75	8 of 14	1,400.00	3,200.00	2,300.00	2 of 2	250.00	3,000.00	1,516.67	3 of 3	0.003	280.00	87.10	3 of 4
xylenes (total)	6.80	160.00	78.20	4 of 5	800.00	3,500.00	2,050.00	2 of 3	62.00	28,000.00	3,518.67	9 of 14	920.00	1,400.00	1,160.00	2 of 2	980.00	2,900.00	1,753.33	3 of 3	10.00	580.00	285.00	2 of 4
Semivolatiles																								
4-chloraniline					790.00	790.00	790.00	1 of 3																
1,4-dichlorobenzene	5.00	59.00	32.25	4 of 5	ND	1100.00J	379.67	2 of 3	21.00	73.00	38.63	8 of 14									25.00	25.00	25.00	1 of 5
1,3-dichlorobenzene	5.40	10.00	7.17	3 of 5	ND	180.00J	43.05	2 of 3	7.50	13.00	10.17	3 of 14									4.50	4.50	4.50	1 of 5
1,2-dichlorobenzene	18.00	370.00	180.60	5 of 5	ND	8,200.00	2,836.67	2 of 3	130.00	960.00	308.89	9 of 14									4.20	230.00	84.40	3 of 5
2,4-dinitrotoluene					ND	4,200.00	1,400.00	1 of 3	22.00	22.00	22.00	1 of 14												
2,6-dinitrotoluene					ND	22,000.00	7,337.33	1 of 3																
2-chloronaphthalene									8.60	220.00	112.15	4 of 14	ND	24.00	12.00	1 of 2					35.00	35.00	35.00	1 of 5
2-methylnaphthalene	58.00	290.00	165.40	5 of 5					19.00	8,100.00	3,698.78	9 of 14									3.60	22.00	15.53	3 of 5
nitrobenzene	4.10	15.00	9.72	5 of 5	ND	1,300.00	530.00	2 of 3	540.00	54,000.00	10,375.56	9 of 14	ND	1,600.00	800.00	1 of 2					5.70	9.90	7.80	2 of 5
1,2,4-trichlorobenzene	2.20	2.70	2.45	2 of 5																	8.40	8.40	8.40	1 of 5
benzoic acid	100.00	100.00	100.00	1 of 5																				
di-n-butyl-phthalate					ND	3.0J	1.00	1 of 3																
di-n-octyl-phthalate	6.90	6.90	6.90	1 of 5																				
dibenzofuran	5.70	40.00	19.48	5 of 5	12J	12J	12J	1 of 3	210.00	660.00	376.25	8 of 14									1.90	9.70	5.47	3 of 5
benzo(a)anthracene	6.40	9.70	8.03	3 of 5					32.00	200.00	116.43	7 of 14									5.20	660.00	331.55	4 of 5
butylbenzylphthalate													ND	5.9J	2.95	1 of 2								
chrysene	5.30	5.30	5.30	1 of 5					14.00	24.00	18.33	3 of 14									9.60	21.00	15.30	2 of 5
bis(2-ethylhexyl)phthalate	12.00	12.00	12.00	1 of 5					18.00	44.00	27.00	4 of 14									4.80	26.00	14.78	4 of 5
benzo(b)fluoranthene	4.60	4.60	4.60	1 of 5					19.00	27.00	24.00	3 of 14												
benzo(k)fluoranthene																								
benzo(a)pyrene	3.20	3.20	3.20	1 of 5																				
2-chlorophenol					ND	10,000.00	3,333.33	1 of 3					ND	10,000.00	5,000.00	1 of 2								
indeno(1,2,3-cd)pyrene																								
naphthalene	720.00	890.00	802.00	5 of 5	330.00	20,000.00	11,443.33	3 of 3	3,300.00	420,000.00	58,255.56	9 of 14	ND	7,800.00	3,900.00	1 of 2					26.00	170.00	66.25	4 of 5
acenaphthene	15.00	48.00	33.00	3 of 5	ND	150.00	50.00	1 of 3	50.00	1,400.00	463.38	8 of 14									14.00	14.00	14.00	1 of 5
acenaphthylene	13.00	17.00	15.00	2 of 5	ND	700.00	233.33	3 of 3	9.00	32.00	20.00	4 of 14												
fluorene	51.00	150.00	113.67	3 of 5	ND	3,800.00	1,266.67	1 of 3	23.00	3,500.00	736.83	8 of 14	ND	250.00	125.00	1 of 2					81.00	81.00	81.00	1 of 5
anthracene	7.80	10.00	8.90	2 of 5	ND	850.00	301.33	2 of 3	33.00	150.00	107.14	7 of 14	ND	2.00J	1.00	1 of 2					5.00	5.00	5.00	1 of 5
fluoranthene	3.50	20.00	9.78	5 of 5					17.00	130.00	66.29	7 of 14									2.00	4.40	3.20	2 of 5
phenanthrene	9.40	42.00	25.28	5 of 5	ND	280.00	100.33	2 of 3	110.00	660.00	387.78	9 of 14									9.00	17.00	10.50	2 of 5
pyrene	3.00	22.00	9.30	5 of 5					24.00	140.00	84.50	6 of 14									1.50	3.40	2.45	2 of 5
trichlorobenzene													ND	31.00	15.50	1 of 2								
diethylphthalate																								
dimethyl phthalate													ND	200.00	100.00	1 of 2								
n-nitrosodiphenylamine	14.00	83.00	36.00	4 of 5					180.00	14,000.00	4,350.00	9 of 14									26.00	450.00	140.00	4 of 5
2,4-dimethylphenol									70.00	190.00	130.00	2 of 14												
2-methylphenol	2.00	3.00	2.50	2 of 5					42.00	620.00	239.00	3 of 14									10.00	10.00	10.00	1 of 5
4-methylphenol									160.00	280.00	227.50	4 of 14									5.00	30.00	17.50	2 of 5
4-nitroaniline	27.00	38.00	32.50	2 of 5																	21.00	21.00	21.00	1 of 5
phenol									150.00	310.00	225.00	4 of 14												
PCBs (total)																								
PCB Aroclor-1242									44.00	79.00	61.50	1 of 12												
PCB Aroclor-1254																					5.70	5.70	5.70	1 of 5
PCB Aroclor-1260	5.40	5.40	5.40	1 of 5																				
Inorganics																								
aluminum	7,050.00	15,800.00	4,836.00	5 of 5					854.00	57,700.00	15,224.89	9 of 13					3,130.00	3,420.00	3,275.00	2 of 2	3,740.00	12,500.00	8,415.00	4 of 4
antimony	4.89	17.40	10.73	3 of 5					4.80	22.10	13.33	3 of 13	ND	33.00	16.50	1 of 2	28.00	663.00	391.30	3 of 3	7.70	43.90	26.15	4 of 4
arsenic	4.10	10.30	6.56	5 of 5	ND	101.00	50.50	1 of 3	6.30	63.10	28.99	9 of 13	ND	101.00	50.50	1 of 2	6.26	8.40	7.33	2 of 2	3.40	43.90	20.10	4 of 4
barium	115.00	592.00	285.20	5 of 5					102.00	7,480.00	2,501.56	9 of 13					38.60	40.50	39.55	2 of 2	577.00	2,840.00	1,739.25	4 of 4
beryllium	0.34	0.94	0.66	3 of 5					0.38	1.60	0.99	2 of 13	ND	0.30	0.15	1 of 2	1.30	1.36	1.33	2 of 2	0.60	0.60	0.60	1 of 4
cadmium	0.49	0.49	0.49	1 of 5					0.75	9.30	5.38	8 of 13	ND	1.30	0.65	1 of 2	1.50	2.03	1.91	3 of 3	7.70	51.20	24.83	4 of 4
calcium	2,430.00	10,500.00	5,324.00	5 of 5					524.00	21,300.00	4,476.22	9 of 13					47,100.00	56,900.00	52,000.00	2 of 2	4,770.00	22,600.00	13,230.00	4 of 4
chromium	64.20	1,540.00	472.58	5 of 5	14.00	14.00	14.00	2 of 3	31.60	3,680.00	1,499.62	9 of 13	55.50	180.00	117.75	2 of 2	1,500.00	58,400.00	34,033.33	3 of 3	57.10	266.00	174.28	4 of 4
cobalt	8.00	17.00	11.66	5 of 5					1.50	25.80	13.37	9 of 13					21.50	27.60	24.55	2 of 2	11.09	125.00	52.05	4 of 4
copper	34.80	812.00	368.46	5 of 5	4.30	20.30	12.30	2 of 3	163.00	3,020.00	1,894.44	9 of 13	64.40	730.00	397.20	2 of 2	1,600.00	8,270.00	5,736.67	3 of 3	594.00	5,290.00	2,516.00	4 of 4
cyanide	7.10	312.00	130.00	3 of 5					12.10	51.30	25.96	7 of 13					2.60	2.72	2.66	2 of 2	1.50	2.30	1.93	3 of 4
iron	25,700.00	36,500.00	30,020.00	5 of 5					4,020.00	230,000.00	76,334.44	9 of 13					44,600.00	53,500.00	49,050.00	2 of 2	20,800.00	112,000.00	64,775.00	4 of 4
lead	66.60	4,980.00	1,035.72	5 of 5	6.00	16.10	11.05	2 of 3	49.50	2,930.00	1,314.39	9 of 13	46.40	320.00	183.20	2 of 2	1,000.00	1,880.00	1,460.00	3 of 3	668.00	38,200.00	10,517.00	4 of 4
magnesium	2,820.00	5,940.00	3,872.00	5 of 5					157.00	4,990.00	1,893.33	9 of 13					4,250.00	4,840.00	4,545.00	2 of 2	1,990.00	11,600.00	6,715.00	4 of 4
manganese	184.00	1,180.00	579.40						134.00	900.00	351.56	9 of 13					362.00	412.00	387.00	2 of 2	347.00	1,390.00	881.25	4 of 4
mercury	0.31	2.00	1.48	5 of 5	ND	0.16	0.08	2 of 3	4.50	199.00	82.27	9 of 13	ND	40.00	20.00	1 of 2	0.27	1.18	0.85	3 of 3	2.10	4.80	3.23	4 of 4
nickel	29.90	65.90	44.32	5 of 5	2.00	5.38	3.65	2 of 3	53.00	464.00	224.87	9 of 13	14.30	58.00	36.15	2 of 2	240.00	462.00	378.67	3 of 3	58.30	829.00	300.33	4 of 4
potassium	640.00	2,260.00	1,206.60	5 of 5					352.00	1,170.00	575.89	9 of 13					1,170.00	1,230.00	1,200.00	2 of 2	372.00	1,250.00	900.75	4 of 4
selenium	0.31	0.48	0.40	2 of 5	0.06	1.90	0.96	2 of 3	0.35	6.10	2.00	8 of 13	0.02	2.40	1.21	2 of 2	0.03	1.36	0.90	3 of 3	1.40	7.60	3.10	4 of 4
silver	29.30	29.30	29.30	1 of 5					2.00	3.90	3.30	6 of 13	ND	0.30	0.15	1 of 2	0.20	2.72	1.84	3 of 3	3.70	21.70	13.05	4 of 4
sodium	875.00	17,300.00	4,975.80	5 of 5					1,040.00	13,000.00	6,514.44	9 of 13					9,200.00	10,800.00	10,000.00	2 of 2	3,380.00	5,470.00	4,415.00	4 of 4
thallium																	2.16	2.72	2.44	2 of 2	1.20	1.20	1.20	1 of 4
vanadium	27.80	42.20	36.42	5 of 5					2.80	70.80	34.64	3 of 13					100.00	107.00	103.50	2 of 2	17.10	61.90	43.25	4 of 4
zinc	165.00	2,470.00	763.20	5 of 5	5.80	35.10	20.45	2 of 3	115.00	3,190.00	836.78	9 of 13	272.00	810.00	541.00	2 of 2	13,800.00	148,000.00	80,900.00	2 of 2	1,030.00	5,820.00	3,035.00	4 of 4

NOTES:
(1) The pumpable tars from Impoundment 4 have been removed and blended in an on-site hazardous waste fuel blending/recycling facility.
(2) The sludge portion detects of Impoundment 5 contents are presented because they represent the highest concentrations.
Therefore, these concentrations pose the greatest potential risk.
(3) Data derived from O'Brien and Gere 1984 Priority Pollutant test results and BBL 06/18/91 test results. No SVOCs detected in either sampling event.
ND - not detected
J - compound is present in a concentration below the minimum detection limit (MDL). The reported value is estimate

Exhibit H

Risk Analysis By Environ Corporation

EXHIBIT H
RISK RANKING EVALUATION
FOR CHEMICALS OF POTENTIAL CONCERN
IN THE GROUP III IMPOUNDMENTS

Prepared for

American Home Products Corporation

Prepared by

ENVIRON Corporation
Princeton, NJ

July 18, 1997

EXHIBIT H

Risk Ranking Evaluation for Chemicals of Potential Concern in the Group III Impoundments

1. Objectives

This Exhibit describes the risk ranking evaluation that was performed to assist in identifying the primary compounds of concern in the Group III Impoundments, and to support the development of treatment objectives. The specific objectives of this evaluation are as follows:

- Identify the chemicals which pose the greatest relative risk (based on toxicity, mobility, and volume) in the Group III impoundments
- Based on the risk ranking, and the prevalence of the constituents across the various impoundments, identify appropriate "indicator" chemicals for evaluating treatment system performance
- Support the development of treatment objectives, based on an analysis of a reduction in relative risk (i.e., toxicity, mobility, volume)

In this analysis, the potential risk posed by chemicals in the Group III Impoundment wastes after remediation is expected to be negligible because the wastes will be deposited in the lined and capped Impound 8 facility, with very limited potential for exposure. Despite the very low likelihood of exposure to constituents in the impoundment wastes after disposal in Impound 8, the terms "potential risk" and "inherent hazard" are used interchangeably throughout this Exhibit.

2. Approach

The first step of this evaluation was to rank the Group III organic chemicals relative to inherent hazard, based on toxicity, mobility, and volume. This objective was met by calculating relative risk factor (RRF) values for the organic compounds detected in the Group III Impoundments. The methodology used for developing the RRF equation is provided in Attachment 1 to this exhibit. In summary, the exposure equations used to evaluate the potential risk posed by ingestion exposure to the chemicals leaching to ground water were simplified to include only the chemical-specific parameters. In this way, the RRF values reflect the relative hazard posed by the individual waste constituents, and account for the toxicity, mobility, and volume of each chemical. As shown in Attachment 1, for chemicals with carcinogenic effects, the RRF is calculated as:

$$RRF_c = RMF \times SF_{oral} \;/\; (K_d \times 10^{-6})$$

For chemicals with noncarcinogenic effects, the RRF is calculated as:

$$RRF_{nc} = RMF \;/\; (RfD_{oral} \times K_d \times 1)$$

A detailed explanation of the calculation of the RRF values, including definitions for RMF, SF_{oral}, RfD_{oral}, and K_d, is provided in Attachment 1.

For chemicals with both carcinogenic and noncarcinogenic effects, both RRF_c and RRF_{nc} values were calculated. The RRF_c and RRF_{nc} values were then compared, and the maximum of the two values was used as the RRF (i.e., RRF_{max}) for the chemical. If a chemical has only one effect (e.g., carcinogenic), the RRF for the other effect (in this case, noncarcinogenic) was entered as zero. The RRF_{max} values were then sorted in decreasing order (i.e., from the chemical with the highest relative risk to the chemical with the lowest relative risk) for further evaluation.

3. Identification of Risk-Based Indicator Chemicals

Results of the risk ranking, including the parameters used in the RRF calculation for each chemical, are provided in Table H-1. As shown on Table H-1, of the constituents detected in the Group III Impoundment waste, benzene represents the highest relative risk. Specifically, the RRF_{max} for benzene is an order of magnitude higher than the RRF_{max} for the next chemical on the list. The five chemicals with the highest RRF_{max} values are (in descending order):

- Benzene
- 4-Nitroaniline
- Nitrobenzene
- Chloroform
- N-Nitrosodiphenylamine

A sensitivity analysis on the RRF_{max} calculations was also performed. In the sensitivity analysis, the K_d term was excluded from the calculation to correspond to a hypothetical direct contact pathway, rather than the leaching to ground water pathway. If the K_d term is excluded from the RRF calculation, benzene is still the chemical with the highest RRF_{max} value. Therefore, benzene represents a majority of the overall inherent hazard of the Group III Impoundment chemicals for both the leaching to ground water and direct contact exposure pathways.

Based on the leaching to ground water RRF values, benzene represents about 94% of the overall inherent hazard of all chemicals in Group III Impoundments, and approximately 95% of the overall cancer hazard of all chemicals in the Group III Impoundments. The most highly ranked noncarcinogen is nitrobenzene, which represents about 90% of the overall noncancer hazard of all chemicals in the Group III Impoundments. Thus, achieving significant reductions in the mass of benzene and nitrobenzene will result in the most significant reduction in the potential cancer and noncancer hazard of the Group III Impoundment wastes.

Of the remaining chemicals within the top five, 4-nitroaniline has the highest RRF_{max} value, based largely on its mobility and its classification as a potential carcinogen. However, 4-nitroaniline is less suitable as an indicator chemical than either benzene or nitrobenzene because it is much less prevalent in the Group III Impoundment wastes. As shown in Table H-1, benzene has been detected in each of Impoundments 1, 2, 3, 4, 5, 14, and 20, which represent 100% of the total volume of the Group III Impoundment wastes to be treated, and nitrobenzene has been detected in Impoundments 1, 2, 3, 5, and 14, which represents about 95% of the total volume. By comparison, 4-nitroaniline has been detected in only one impoundment (Impoundment 5), which represents approximately 50% of the total volume. Furthermore, 4-nitroaniline is classified by USEPA as a Group C carcinogen (possible human carcinogen, based on no human data and limited data in animals[1]), whereas benzene is classified by USEPA as a Group A carcinogen (human carcinogen). When 4-nitroaniline is evaluated as a noncarcinogen only, it ranks lower than the other four chemicals on the list above (i.e., it does not rank as one of the five chemicals with the highest RRF_{max} values). Therefore, 4-nitroaniline is less appropriate as an indicator chemical than either benzene or nitrobenzene.

Both of the remaining two chemicals within the top five based on the RRF_{max} values (chloroform and n-nitrosodiphenylamine) received lower RRF scores than either benzene or nitrobenzene, and are also less prevalent in the Group III Impoundment wastes than either benzene or nitrobenzene. Chloroform and n-nitrosodiphenylamine are thus also less appropriate indicator chemicals from the perspective of risk reduction.

The selection of indicator chemicals for monitoring treatment system performance is described in Section 5 of the CMS/FS. The indicator chemicals selected in Section 5 include benzene and nitrobenzene.

4. Treatment Objectives

As discussed above, a reduction in the mass of benzene would lead to the greatest reduction in overall inherent hazard (i.e., toxicity, mobility, volume). Based on the data presented in Table H-1, reducing the benzene concentration to 2,000 mg/kg across all impoundments would reduce the overall inherent hazard of the Group III Impoundment wastes by approximately 90%. If the benzene concentration is reduced to 200 mg/kg across all Group III Impoundments, the reduction in the overall inherent hazard of Group III Impoundment wastes would approach 99%, given anticipated corresponding reductions for other waste constituents based on the O'Brien & Gere treatability studies. Thus, a treatment objective for benzene in the range of 2,000 mg/kg to 200 mg/kg would correspond to a reduction of 90% to 99% in the overall inherent hazard of the Group III Impoundment wastes.

Based on the treatability study results, treatment objectives of 54 mg/kg (6-month average) and 60 mg/kg (maximum value) have been established for benzene (see Section 5 of the CMS/FS). Treatment objectives based on the treatability studies have also been selected for the most prevalent constituents detected in the Group III Impoundment wastes (nitrobenzene, n-nitrosodiphenylamine, naphthalene, toluene, 2-methylnaphthalene, 1,2-dichlorobenzene, and xylenes). The "maximum value" treatment objectives for these compounds are presented in Table H-2. As shown in Table H-2, meeting the "maximum value" treatment objectives for benzene and the other prevalent compounds corresponds to a 99% reduction in the overall inherent hazard of the Group III Impoundment wastes. Potential risk reductions from treatment of the Group III Impoundment wastes to the "6-month average" concentrations,

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[1] USEPA, NCEA. *Draft Risk Assessment Issue Paper for Derivation of a Provisional Oral RfD, Slope Factor, and Unit Risk for 3-Nitroaniline and 4-Nitroaniline.* August 20, 1993.

which are lower than the “maximum value” concentrations, also correspond to a 99% reduction in the overall inherent hazard of the Group III Impoundment wastes (primarily because the greatest potential risk reduction is associated with benzene, and the post-treatment “maximum value” and “6-month average” benzene concentrations differ by only 10%).

Table H-1
Group III Impoundments - Risk Ranking Factor Calculations

Chem Group	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Impound 1 Max. Conc. (mg/kg)	Impound 2 Max. Conc. (mg/kg)	Impound 3 Max. Conc. (mg/kg)	Impound 4 Max. Conc. (mg/kg)	Impound 5 Max. Conc. (mg/kg)	Impound 14 Max. Conc. (mg/kg)	Impound 20 Max. Conc. (mg/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}
	Relative density ratio:							1	1	1	1	1	1	1				
	…lume of impoundment (cubic yards):							1.95E+04	2.40E+04	1.68E+04	9.00E+02	7.50E+04	4.00E+03	7.80E+03	1.48E+05	= total volume (cubic yards)		
C	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	3.87E+04	6.10E+04	3.60E+04	2.10E+04	7.80E+02	3.50E+02	5.20E+03	2.94E+09	0.00E+00	3.56E+14	3.56E+14
OC	4-Nitroaniline	100-01-6	C	3.80E-02	3.00E-03	1.20E+01	2.40E-02					1.40E+02			1.05E+07	1.46E+11	1.66E+13	1.66E+13
OC	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	3.65E+02	1.33E+03	5.30E+02		1.60E+03	9.00E+03		2.04E+08	3.19E+12	0.00E+00	3.19E+12
C	Chloroform	67-66-3	B2	6.10E-03	1.00E-02	7.70E+01	1.54E-01	1.26E+00				8.00E+02			6.00E+07	3.90E+10	2.38E+12	2.38E+12
OC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00			1.50E+02		4.60E+03	2.20E+04	1.70E+01	4.36E+08	0.00E+00	8.21E+11	8.21E+11
OC	1,4-Dichlorobenzene	106-46-7	C	2.40E-02		2.30E+03	4.60E+00	3.86E+01	5.88E+02	1.20E+03		2.00E+02		4.40E+00	5.01E+07	0.00E+00	2.61E+11	2.61E+11
OC	Naphthalene	91-20-3	D		4.00E-02	2.00E+03	4.00E+00	1.39E+03	9.86E+03	2.40E+04		2.40E+05	3.60E+04	3.70E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11
OC	3-Nitroaniline	99-09-2	C	3.80E-02	3.00E-04	1.82E+01	3.64E-02							3.80E+00	2.96E+04	2.71E+09	3.09E+10	3.09E+10
OC	Benzo(a)anthracene	56-55-3	B2	7.30E-01		4.00E+05	8.00E+02					3.60E+02	2.70E+02		2.81E+07	0.00E+00	2.56E+10	2.56E+10
C	Chloromethane	74-87-3	C		4.00E-03	7.80E+00	1.56E-02	5.72E+01							1.12E+06	1.79E+10	0.00E+00	1.79E+10
OC	Benzoic Acid	65-85-0			4.00E+00	6.00E-01	1.20E-03	3.62E+02	8.84E+02						2.83E+07	5.89E+09	0.00E+00	5.89E+09
C	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	1.01E+02	1.62E+04	9.10E+03	3.10E+03	3.00E+03	8.20E+02	8.60E+01	7.75E+08	3.80E+09	0.00E+00	3.80E+09
OC	2,4-Dinitrotoluene	121-14-2			2.00E-03	9.50E+01	1.90E-01			6.30E+01					1.06E+06	2.79E+09	0.00E+00	2.79E+09
C	Chlorobenzene	108-90-7			2.00E-02	6.50E+02	1.30E+00					9.60E+01	2.20E+03	4.10E+03	4.80E+07	1.85E+09	0.00E+00	1.85E+09
OC	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	1.69E+02	1.52E+03	1.70E+03		1.20E+04	2.40E+03		9.78E+08	1.65E+09	0.00E+00	1.65E+09
OC	Phenol	108-95-2	D		6.00E-01	2.90E+01	5.80E-02	3.53E+01	3.82E+01	2.40E+02		3.20E+02		6.40E+00	2.97E+07	8.53E+08	0.00E+00	8.53E+08
C	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.10E+02	2.21E+03	1.10E+04		1.50E+03	1.30E+02	9.60E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08
C	4-Chloroaniline	106-47-8			4.00E-03	6.60E+01	1.32E-01							2.30E+01	1.79E+05	3.40E+08	0.00E+00	3.40E+08
C	Fluorene	86-73-7	D		4.00E-02	1.40E+04	2.80E+01		4.73E+02	2.80E+03		3.20E+03	3.80E+02		3.00E+08	2.68E+08	0.00E+00	2.68E+08
C	2,4-Dimethylphenol	105-67-9			2.00E-02	2.10E+02	4.20E-01	1.17E+01	2.71E+01				1.10E+02		1.32E+06	1.57E+08	0.00E+00	1.57E+08
C	Acenaphthene	83-32-9			6.00E-02	7.10E+03	1.42E+01	1.02E+01	3.14E+02			1.40E+03	9.40E+02		1.16E+08	1.37E+08	0.00E+00	1.37E+08
C	2-Methylphenol	95-48-7	C		5.00E-02	5.40E+01	1.08E-01			4.20E+01					7.06E+05	1.31E+08	0.00E+00	1.31E+08
	Ethyl Benzene	100-41-4	D		1.00E-01	1.20E+03	2.40E+00	1.14E+02			1.20E+03	1.70E+02	7.50E+01	1.00E+03	2.42E+07	1.01E+08	0.00E+00	1.01E+08
C	Phenanthrene	85-01-8	D		4.00E-02	1.40E+04	2.80E+01	2.79E+01	1.84E+02	3.60E+02		1.30E+03	3.40E+02		1.10E+08	9.81E+07	0.00E+00	9.81E+07
C	1,2,4-Trichlorobenzene	120-82-1	D		1.00E-02	8.80E+03	1.76E+01			7.00E+01			3.20E+03		1.40E+07	7.94E+07	0.00E+00	7.94E+07
	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	1.76E+03	3.44E+03	2.30E+03	1.00E+03	2.20E+03	8.40E+02	5.50E+03	3.68E+08	7.07E+07	0.00E+00	7.07E+07
	Carbon Disulfide	75-15-0			1.00E-01	9.30E+01	1.86E-01	4.44E+01							8.66E+05	4.65E+07	0.00E+00	4.65E+07
C	Dimethylphthalate	131-11-3			1.00E+01	3.50E+01	7.00E-02						3.50E+03		1.40E+07	2.00E+07	0.00E+00	2.00E+07
C	1,3-Dichlorobenzene	541-73-1	D		9.00E-02	1.70E+03	3.40E+00		1.15E+02	1.90E+02					5.95E+06	1.95E+07	0.00E+00	1.95E+07
C	2-Chloronaphthalene	91-58-7			8.00E-02	4.80E+03	9.60E+00	1.01E+02	3.78E+02				6.00E+02		1.34E+07	1.75E+07	0.00E+00	1.75E+07
C	Acenaphthylene	208-96-8	D		4.00E-02	4.90E+03	9.80E+00			3.30E+02					5.54E+06	1.41E+07	0.00E+00	1.41E+07
C	Dibenzofuran	132-64-9	D		6.00E-01	7.94E+03	1.59E+01	3.58E+01	2.47E+02	1.90E+02		1.40E+03	7.80E+02		1.18E+08	1.24E+07	0.00E+00	1.24E+07
C	Anthracene	120-12-7	D		3.00E-01	2.12E+04	4.24E+01					5.60E+02	1.10E+02		4.24E+07	3.33E+06	0.00E+00	3.33E+06
C	Fluoranthene	206-44-0	D		4.00E-02	1.10E+05	2.20E+02	1.04E+01	3.70E+01			2.60E+02			2.06E+07	2.34E+06	0.00E+00	2.34E+06
C	Pyrene	129-00-0	D		3.00E-02	1.10E+05	2.20E+02	1.16E+01		4.00E+01		1.80E+02			1.44E+07	2.18E+06	0.00E+00	2.18E+06

…es:

References for the toxicity and transport values are provided in Attachment 2 to Exhibit H.
The relative density ratios and impoundment volumes used in this analysis represent the waste volumes to be treated (Waste Categories A, B, C). Volumes and densities for these waste categories are reported in Table 2-1 of the CMS/FS.
The concentration data used in this analysis represents the maximum chemical concentration reported in Table A-1 of the CMS/FS.
The references noted in 1-3 above are further discussed in Attachment 1 to Exhibit H.

Table H-2

Group III Impoundments -
Risk Reduction Factors Calculated Using Treatment Objectives

m up	Compound Name	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$	RfD_{oral} (mg/kg/d)	K_{oc} (L/kg)	K_d (L/kg)	Relative Mass Factor (RMF)	RRF_{nc} at HQ = 1	RRF_c at RT = 10^{-6}	RRF_{max}	Group III Treatment Objective, "maximum value" (mg/kg)	RMF at Treatment Objective	RRF_{nc} at HQ = 1, at Treatment Objective	RRF_c at RT = 10^{-6} at Treatment Objective	RRF_{max}, at Treatment Objective
	Benzene	71-43-2	A	2.90E-02		1.20E+02	2.40E-01	2.94E+09	0.00E+00	3.56E+14	3.56E+14	6.00E+01	8.88E+06	0.00E+00	1.07E+12	1.07E+12
	Nitrobenzene	98-95-3			5.00E-04	6.40E+01	1.28E-01	2.04E+08	3.19E+12	0.00E+00	3.19E+12	5.20E+03	1.89E+08	2.95E+12	0.00E+00	2.95E+12
	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1.30E+03	2.60E+00	4.36E+08	0.00E+00	8.21E+11	8.21E+11	1.43E+04	4.05E+08	0.00E+00	7.63E+11	7.63E+11
	Naphthalene	91-20-3	D		4.00E-02	2.00E+03	4.00E+00	1.88E+10	1.18E+11	0.00E+00	1.18E+11	1.31E+04	1.52E+09	9.49E+09	0.00E+00	9.49E+09
	Toluene	108-88-3	D		2.00E-01	5.10E+02	1.02E+00	7.75E+08	3.80E+09	0.00E+00	3.80E+09	1.45E+02	2.01E+07	9.87E+07	0.00E+00	9.87E+07
	2-Methylnaphthalene	91-57-6			4.00E-02	7.41E+03	1.48E+01	9.78E+08	1.65E+09	0.00E+00	1.65E+09	1.90E+03	2.18E+08	3.68E+08	0.00E+00	3.68E+08
	1,2-Dichlorobenzene	95-50-1	D		9.00E-02	2.40E+03	4.80E+00	3.57E+08	8.26E+08	0.00E+00	8.26E+08	3.20E+02	4.37E+07	1.01E+08	0.00E+00	1.01E+08
	Xylenes (total)	1330-20-7	D		2.00E+00	1.30E+03	2.60E+00	3.68E+08	7.07E+07	0.00E+00	7.07E+07	2.30E+02	3.40E+07	6.55E+06	0.00E+00	6.55E+06
										Total RRF for chemicals with treatment objectives:	3.60E+14					4.80E+12
										Percent reduction in Total RRF:						99%

Note: "Group III Treatment Objectives" presented in Section 5 of the CMS/FS.

Attachment 1 to Exhibit H
Methodology for Developing the Risk Ranking Factor Equation

1. Overview

The relative risk ranking developed for this analysis takes into account the toxicity, mobility, and volume of a chemical in the Group III Impoundments. This attachment presents the technical basis for the ranking approach, and how individual parameters representing toxicity, mobility, and volume were combined into a relative risk factor (RRF) for each of the Group III chemicals of potential concern.

2. Toxicity

As discussed in the CMS/FS, hazardous wastes from the Group III Impoundments will ultimately be deposited into the Impound 8 facility, which is being constructed with an impermeable cap, a triple liner, and leachate collection systems. Ground water in the vicinity of the Impound 8 facility is also contained by an interceptor trench. Thus, the potential for exposure through any pathway will essentially be eliminated. However, for the purposes of the risk ranking, it is assumed that the pathway of greatest potential concern is ingestion of ground water as a drinking water source. For this reason, oral toxicity data was used in this evaluation to estimate the toxicity associated with the chemicals of potential concern. For potential carcinogens, oral slope factor values (SF_{oral}) from USEPA were used as a measure of carcinogenic potency; for noncarcinogens, chronic oral reference dose values (RfD_{oral}) from USEPA were used as a measure of noncancer toxicity. A summary of the SF_{oral} and RfD_{oral} values used for this evaluation is presented in Attachment 2 to Exhibit G.

3. Mobility

Since ground water is the pathway for which the RRF evaluation is performed, the appropriate measure of mobility is the soil-to-water partitioning coefficient (K_d). For organic chemicals, the K_d value is:

$$K_d = K_{oc} \times f_{oc}$$

where:

K_{oc}	=	organic carbon partitioning coefficient (L-water/kg-organic carbon)
f_{oc}	=	organic carbon weight fraction in soil (unitless), assume = 0.002 for this analysis

Since no K_{oc} or f_{oc} data is available for the Group III Impoundment wastes, USEPA-published K_{oc} and f_{oc} data for soils were used for this analysis. The selection of a specific value for f_{oc} has no impact on the results of the relative risk ranking, because it is a constant and has an equal effect on the RRF for all chemicals. A summary of the K_d values used for this evaluation is presented in Attachment 2 to Exhibit G.

4. Volume

The volume of each constituent was represented by a relative mass factor (RMF), which takes into account the volume and density of the waste in each impoundment and the concentration of each chemical in each impoundment, as follows:

$$RMF = \sum_{i,j} (C_{ij})\ (V_j)\ (D_j)$$

where:

C = concentration of chemical I in Impoundment j (mg/kg)
V = volume of waste in Impoundment j (cubic yards)
D = relative density ratio of waste in Impoundment j (unitless)

Inputs to the RMF calculation are further discussed below.

a. Concentration

The maximum detected chemical concentration for each impoundment from Table A-1 of the CMS/FS was used in this analysis. This approach for calculating the concentration term is consistent with USEPA's *Risk Assessment Guidance for Superfund, Volume I*; according to USEPA, use of the maximum detected concentration (rather than the 95% upper confidence limit on the mean) where there is a limited data set is appropriate. If a chemical was detected in a given impoundment, but not detected in a specific sample within the impoundment (i.e., concentration reported below detection limits on Table A-1), half of the chemical's detection limit was used to represent the concentration of the chemical in the given sample. However, since the maximum detected chemical concentration was used to represent the chemical concentration in the entire impoundment (rather than the 95% upper confidence limit on the mean), it was unnecessary to use the half detection limits in any of the risk ranking calculations. Consistent with USEPA's *Risk Assessment Guidance for Superfund, Volume I*, a chemical was assumed not to be present in a given impoundment if it was not detected in any sample from that impoundment.

A summary of the concentration data used for this evaluation is presented in Table H-1.

b. Volume

The volume of the impoundment wastes in Waste Categories A, B, and C were used in this evaluation. Since wastes in Waste Category D will not be treated for organics and Waste Category E will not be treated, waste volumes in these categories were subtracted from the total volume for an impoundment, if applicable. For example, the total volume of Impoundment 5 is 110,300 cubic yards. Of this, 35,300 cubic yards is in Waste Categories D and E, so the volume of Impoundment 5 used in this analysis is 75,000 cubic yards. A summary of the impoundment volumes used for this evaluation is presented in Table H-1.

c. **Relative Density Ratio**

As noted in Table 2-1 of the CMS/FS, the waste densities are relatively similar for the various impoundments; therefore, the relative density ratio used in this evaluation was set to 1 for all impoundments (i.e., there are no significant differences in waste densities across the various impoundments).

5. Calculation of Relative Risk Factor

Each of the toxicity, mobility and volume factors were combined in a relative risk factor (RRF) equation. This equation was based on the equations which are used to evaluate risks from ingestion of ground water:

$$\text{Cancer Risk} = C_{gw} \text{ x } SF_{oral} \text{ x Intake}$$

For noncancer effects:

$$\text{Hazard Quotient (HQ)} = \frac{C_{gw} \text{ x Intake}}{RfD_{oral}}$$

where:

C_{gw} = concentration of chemical in the ground water (mg/L)
Sf_{oral} = oral slope factor $(mg/kg/day)^{-1}$
RfD_{oral} = oral reference dose (mg/kg/day)
Intake = ground water intake (L/kg-day)

In the factors considered in the calculation of risk, only the concentration (C_{gw}) and toxicity factors (SF_{oral} and RfD_{oral}) are chemical-dependent; ground water intake is not chemical-dependent. Because the objective of this analysis is to rank the Group III impoundment organic chemicals *relative* to one another (i.e., not an actual calculation of risk), the intake portion of the risk evaluation can be eliminated since it would be the same for all chemicals.

For estimation of carcinogenic risk, the risk equation therefore becomes:

$$\text{Relative Cancer Risk } (RRF_c) = C_{gw} \text{ x } SF_{oral}$$

For estimation of noncarcinogenic risk, the risk equation therefore becomes:

$$\text{Relative HQ } (RRF_{nc}) = C_{gw} \ / \ RfD_{oral}$$

Since the ground water concentration is estimated as the chemical concentration in the solid (C_s) divided by the K_d, the relative risk equations become:

$$RRF_c = C_s \times SF_{oral} / K_d$$

$$RRF_{nc} = C_s / (RfD_{oral} \times K_d)$$

To account for the volume as well as the concentration of the individual constituents, the relative mass factor (RMF) is substituted for C_s. Furthermore, in order to allow for a combined ranking of both cancer and noncancer effects, a risk target of 10^{-6} was used for carcinogenic risk, and a HQ target of 1.0 was used for noncancer risk. Substituting these factors into the general risk equation results in the following:

$$RRF_c = RMF \times SF_{oral} / (K_d \times 10^{-6})$$

$$RRF_{nc} = RMF / (RfD_{oral} \times K_d \times 1)$$

RRFs calculated for this evaluation are listed in Table H-1.

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Exhibit H
Attachment 2
Toxicity and Transport Values Used in the Risk Ranking Factor Calculations

Chem Group	Constituent	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$			RfD_{oral} (mg/kg/d)			K_{oc} (L/kg)	
				Value	Notes	Ref	Value	Notes	Ref	Value	Ref
VOC	Benzene	71-43-2	A	2.90E-02	26	1		6		1.20E+02	40
VOC	Carbon Disulfide	75-15-0					1.00E-01		1	9.30E+01	40
VOC	Chlorobenzene	108-90-7					2.00E-02		1	6.50E+02	40
VOC	Chloroform	67-66-3	B2	6.10E-03		1	1.00E-02		1	7.70E+01	40
VOC	Chloromethane	74-87-3	C		14	35	4.00E-03	6	34	7.80E+00	40
VOC	Ethyl Benzene	100-41-4	D				1.00E-01		1	1.20E+03	40
VOC	Toluene	108-88-3	D				2.00E-01		1	5.10E+02	40
VOC	Xylenes (total)	1330-20-7	D				2.00E+00		1	1.30E+03	40
SVOC	1,2,4-Trichlorobenzene	120-82-1	D				1.00E-02		1	8.80E+03	40
SVOC	1,2-Dichlorobenzene	95-50-1	D				9.00E-02		1	2.40E+03	40
SVOC	1,3-Dichlorobenzene	541-73-1	D				9.00E-02	10		1.70E+03	2
SVOC	1,4-Dichlorobenzene	106-46-7	C	2.40E-02	6	2				2.30E+03	40
SVOC	2,4-Dimethylphenol	105-67-9					2.00E-02		1	2.10E+02	40
SVOC	2,4-Dinitrotoluene	121-14-2					2.00E-03		1	9.50E+01	40
SVOC	2-Chloronaphthalene	91-58-7					8.00E-02		1	4.80E+03	3
SVOC	2-Methylnaphthalene	91-57-6					4.00E-02	9,21		7.41E+03	6
SVOC	2-Methylphenol	95-48-7	C				5.00E-02		1	5.40E+01	34
SVOC	3-Nitroaniline	99-09-2	C	3.80E-02	22	44	3.00E-04		44	1.82E+01	6
SVOC	4-Chloroaniline	106-47-8					4.00E-03		1	6.60E+01	40
SVOC	4-Nitroaniline	100-01-6	C	3.80E-02	22	44	3.00E-03		44	1.20E+01	6
SVOC	Acenaphthene	83-32-9					6.00E-02		1	7.10E+03	40
SVOC	Acenaphthylene	208-96-8	D				4.00E-02	9		4.90E+03	34
SVOC	Anthracene	120-12-7	D				3.00E-01		1	2.12E+04	34
SVOC	Benzo(a)anthracene	56-55-3	B2	7.30E-01	5	10				4.00E+05	40
SVOC	Benzoic Acid	65-85-0					4.00E+00		1	6.00E-01	34
SVOC	bis(2-Ethylhexyl)phthalate	117-81-7	B2	1.40E-02		1	2.00E-02		1	1.50E+07	40
SVOC	Dibenzofuran	132-64-9	D				6.00E-01	14	4	7.94E+03	6
SVOC	Dimethylphthalate	131-11-3					1.00E+01	18	2	3.50E+01	40
SVOC	Fluoranthene	206-44-0	D				4.00E-02		1	1.10E+05	40
SVOC	Fluorene	86-73-7	D				4.00E-02		1	1.40E+04	40
SVOC	N-Nitrosodiphenylamine	86-30-6	B2	4.90E-03		1				1.30E+03	40

Exhibit H
Attachment 2
Toxicity and Transport Values Used in the Risk Ranking Factor Calculations

Chem Group	Constituent	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$			RfD_{oral} (mg/kg/d)			K_{oc} (L/kg)	
				Value	Notes	Ref	Value	Notes	Ref	Value	Ref
SVOC	Naphthalene	91-20-3	D				4.00E-02		43	2.00E+03	40
SVOC	Nitrobenzene	98-95-3					5.00E-04	6	1	6.40E+01	40
SVOC	Phenanthrene	85-01-8	D				4.00E-02	9		1.40E+04	3
SVOC	Phenol	108-95-2	D				6.00E-01		1	2.90E+01	40
SVOC	Pyrene	129-00-0	D				3.00E-02		1	1.10E+05	40

Exhibit H
Attachment 2
Toxicity Value Notes

Note ID	Comment
5	Based on analogy to Benzo(a)pyrene [CASRN 50-32-8] using USEPA relative potency scheme described in reference 10.
6	Under review, according to IRIS.
9	ENVIRON used Naphthalene [CASRN 91-20-3] value from NCEA (reference 43) as a surrogate.
10	ENVIRON used 1,2-Dichlorobenzene [CASRN 95-50-1] values from IRIS {chronic RfDo} (reference 1) and HEAST {chronic RfDi} (reference 2) as surrogates.
14	Data inadequate for quantitative risk assessment, according to IRIS.
18	Not verifiable, according to IRIS.
21	NCEA's Risk Assessment Issue Paper for: 2-Methylnapthalene [CASRN 91-57-6] states that use of Naphthalene as a surrogate for 2-Methylnaphthalene was considered, but the uncertainties in such an approach appear to be too great to warrant its use.
22	NCEA's Risk Assessment Issue Paper for: 3-Nitroaniline [CASRN 99-09-2] and 4-Nitroaniline [CASRN 100-01-6] (reference 44) provides a range of 2.0e-2 to 3.8e-2 (mg/kg-day)-1 as the oral slope factor derived for both 3-Nitroaniline and 4-Nitroaniline.
26	USEPA obtained value by route-to-route extrapolation.

Exhibit H
Attachment 2
Toxicity Value References

Ref ID	Reference
1	USEPA. Integrated Risk Information System (IRIS). On-line database.
2	USEPA. 1995. Health Effects Assessment Summary Tables (HEAST). EPA 540/R-95/036. May. and FY-1995 Supplement to HEAST. EPA/540/R-95/142. November.
4	National Cancer Institute (NCI). 1978. Bioassay of dibenzo-p-dioxin for possible carcinogenicity [CASRN 262-12-4]. US Department of Health, Education and Welfare. NTIS PB-288-475.
10	USEPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/2-93/089. July.
34	USEPA. NCEA. 1994. Risk Assessment Issue paper for: Derivation of a Provisional RfD for Chloromethane [CASRN 74-87-3]. March 21.
35	USEPA. NCEA. 1994. Risk Assessment Issue paper for: Quantitative Cancer Risk Assessment for Chloromethane [CASRN 74-87-3]. June 17.
43	USEPA. NCEA. 1995. Risk Assessment Issue paper for: Provisional Oral RfD for Napthalene [CASRN 91-20-3]. Paper received on February 3, 1995.
44	USEPA. NCEA. 1993. Risk Assessment Issue paper for: Derivation of a Provisional Oral RfD, Slope Factor, and Unit Risk for 3-Nitroaniline (CASRN 99-09-2) and 4-Nitroaniline (CASRN 100-01-6). August 20.

Exhibit H
Attachment 2
Transport Value References

Ref ID	Reference
2	USEPA. 1986. Superfund Public Health Evaluation Manual (SPHEM). Office of Emergency and Remedial Response. Office of Solid Waste and Emergency Response. OSWER Directive 9285.4-1. October.
3	USEPA. 1982. Mabey, W., J. Smith, R. Podoll, H. Johnson, T. Mill, T. Chou, J. Gates, I. Partridge, and D. Vandenberg. Aquatic Fate Process Data for Organic Priority Pollutants. Final. Office of Water Reg. & Standards. EPA-440/4-81-014. December.
6	Montgomery, J.H. and L.M. Welkom. 1990. Groundwater Chemicals Desk Reference. Lewis Publishers: Chelsea, MI.
34	USEPA. 1994. Technical Background for Soil Screening Guidance. Office of Emergency and Remedial Response. EPA/540/R-94/106. Review Draft. November.
40	Research Triangle Institute, Center for Environmental Analysis. 1995. Supplemental Technical Support Document for Hazardous Waste Identification Rule: Risk Assessment for Human and Ecological Receptors--Volume 1, TABLE A-1. November 1995.

file Group III

RECEIVED

OCT 7 1997

P.W. McDONALD

State of New Jersey

Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

SEP 30 1997

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
NO. P519 590 866

Ms. Patricia Wells McDonald, Manager
Department of Environment & Safety
American Home Products Corporation
One Campus Drive
Parsippany, NJ 07054

Dear Ms. McDonald:

Re: American Cyanamid /American Home Products Site
Bridgewater Township, Somerset County

The New Jersey Department of Environmental Protection (NJDEP) and the United States Environmental Protection Agency (USEPA) have reviewed the revised Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS) Report dated July 1997 (received on 22 JUL 1997), prepared by O'Brien & Gere (OBG). The revised CMS/FS Report is acceptable provided the following comments are incorporated:

1. General: Throughout the report, there are references to Toxicity Characteristics Leaching Procedure (TCLP) testing for metals in the event that pre-treatment material does not pass this criteria. The necessary TCLP testing must be performed during the implementation of the remedial action to verify that Biotreatment and Low Temperature Thermal Treatment (LTTT) do not increase the leachability of the impoundment material, and that the achievement of unconfined compressive strength requirements ensures compliance with the TCLP levels for metals. If this can be demonstrated initially, then a reduced frequency of post-treatment TCLP testing would be appropriate.

2. Section 1.1, Page 1-1, Paragraph 3: State here that Record of Decision (ROD) for Group II Impoundments (15, 16, 17 and 18) was issued by NJDEP in July 1996.

3. Section 1.1, Page 1-2, Paragraph 3, Second Sentence: Delete the phrase "and LDRs and Superfund 6A variance levels are not applicable".

14. Appendix G, Material Categories A and B, Tables: The columns entitled "Revised Treatment Objectives: must indicate whether these are average or maximum treatment objectives. A footnote must be added to specify how all of the objectives (not only the major compound of concern) were calculated.

15. Appendix H: Include information which was provided to USEPA on 4 SEP 1997.

    The after-biotreatment percentages provided in the tables on Pages 1 and 2 appear to be slightly different from the calculated values. For example, on Page 1, the total mass remaining after biotreatment is equal to 230,467,800 - (45,189,391 - 3,245,266) = 188,523,675 pounds. Therefore, the after-biotreatment percentage is 3,245,266/188,523,675 = 0.017 (or 1.7%). The following percentages for compounds on Page 2 were similarly determined: Naphthalene-1.05%, Nitrobenzene-0.07%, N-Nitrosodiphenylamine-0.21% and 2-Methylnaphthalene-0.15%. While these percentages are very close to the percentages provided in both tables, they nevertheless differ. This discrepancy must be addressed.

    Explain differences in terms "regulated" and "non-regulated". Also, provide a table in the text listing the regulated compounds.

Please submit the revised CMS/FS report incorporating the above comments within 30 calendar days after receipt of this letter.

If you have any questions, please contact me at (609) 633-0718.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Mr. Jim Hacklar, USEPA-SUPERFUND

4. Section 1.2: Update it to indicate that the RODs for Group II Impoundments and Hill Property have been issued by NJDEP in July 1996. Also provide a brief discussion here for the Hazardous and Solid Waste Amendment (HSWA) Permit and its modification.

5. Section 5.22, Pages 5-5 and 5-8, Tables of Treatment Levels: Include a footnote explaining how the overall average and standard deviation were calculated.

6. Section 5.4, Page 5-14, Table: Provide a detailed footnote as to how the treatment levels were determined. The current footnote under of the table references Section 5.7, which cannot be found in the CMS/FS. This discrepancy must be addressed.

7. Section 5.6, Page 5-17, Last Paragraph: Revise it as follows: Based on the heterogeneity of the material, the monitoring period for average compliance is proposed as six months. The frequency of monitoring for maximum treatment objectives will be established during the remedial design phase of this program. However, it should be noted that the maximum treatment objectives represent the maximum values obtained during any sampling day (i.e., a daily maximum). Sampling will be performed during initial raw material characterization, after treatment and prior to final placement in Impoundment 8.

   Note: This text revision does not imply that NJDEP and USEPA are requiring a daily sampling frequency. The purpose of the revision is only to clarify the meaning of the term "maximum treatment objectives".

8. Section 6.4.2, Page 6-18, Paragraph 2: It is stated that debris would be separated from the impoundment materials. State here that Section 6.5.2 provided detailed discussion for the debris.

9. Sections 8.2, 8.3, 8.4 and 8.5: Include the following in appropriate sections: Alternatives (A3 and A4), (B3, B4 and B5), (C3 and C4) and (D2) would permanently reduce the levels of contaminants that are present in the impoundment material.

10. Section 9.3, Page 9-3, Bullet 1: We do not agree that bioremediation will be as effective in removing compounds of concern as thermal. As such, revise as follows: Bioremediation would be effective in reducing the compound of concern for material category B.

11. Section 9.4: Include as-built details and diagrams for the Impoundment 8 Facility.

12. Tables: Remove duplicate pages of Tables 8-17 through 8-23.

13. Figure 9-1: Revise to reflect the current schedule.

O'BRIEN & GERE
ENGINEERS, INC.

October 24, 1997

Mr. Haiyesh Shah
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Federal Case Management
401 East State Street
Trenton, New Jersey 08625

Re: Group III CMS/FS - Final Revisions

File: 5772.013 - Task 6#2

Dear Mr. Shah:

Please find enclosed the revised pages of the Group III CMS/FS which address the NJDEP and USEPA comments as provided in your September 30, 1997 letter. Revisions are provided in redline/strikeout format, with a hand-written reference to the comment provided in the margin. During your review, please note the following:

- Comment 1 requires no response in the CMS/FS but will be addressed in the Remedial Design Report.
- Comment 12 will be addressed during the final submittal and distribution.

Please notify Mr. Thomas Donohue of American Home Products upon your review and concurrence of the enclosed revisions. Based on the receipt of NJDEP's letter on October 7, 1997, we are planning to transmit the final CMS/FS to the agencies by November 6, 1997.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Angelo J. Caracciolo, III
Project Associate

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cc: Mr. Jim Hacklar, USEPA, Region II - Superfund
Mr. Thomas M. Donohue, American Home Products Corporation
Mr. Gary A. Angyal, O'Brien & Gere Engineers, Inc.
Mr. Steven J. Roland, O'Brien & Gere Engineers, Inc.

O'Brien & Gere Engineers, Inc., an O'Brien & Gere company
Raritan Plaza I / Edison, NJ 08837 / (908) 225-7380 FAX (908) 225-7931
. . . and offices in major U.S. cities

1. Introduction

1.1. Overview and objectives

This CMS/FS Report has been prepared on behalf of AHPC for the Group III impoundments at the American Cyanamid Company (Cyanamid) facility located in Bridgewater Township, Somerset County, New Jersey (Bound Brook facility). Cyanamid has been a wholly owned subsidiary of AHPC since November 1994.

Cyanamid entered into ACOs with the NJDEP related to investigation and remediation at the Bound Brook facility in 1982 and 1988; the 1988 ACO was amended in 1994. The USEPA is a support agency to the NJDEP on this project. The 1988 ACO required corrective action for sixteen impoundments at the Bound Brook facility. In order to facilitate remedial alternative evaluation and remediation management; Cyanamid, NJDEP, and USEPA agreed to organize these sixteen impoundments into three groups according to impoundment material types, impoundment constituents, impoundment location, and potential remedial alternatives. These sixteen impoundments were grouped as follows:

- Group I - Impoundments 11, 13, 19, and 24
- Group II - Impoundments 1, 2, 15, 16, 17, and 18
- Group III - Impoundments 3, 4, 5, 14, 20, and 26.

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The Group I CMS/FS was submitted to NJDEP and USEPA in 1992 and a Record of Decision was issued on September 28, 1993. The Group II CMS/FS (Impoundments 15, 16, 17, and 18) was submitted to NJDEP and USEPA in May 1994 and a Record of Decision ~~is pending~~ was issued in July 1996.

The conclusions and recommendations for Impoundments 1 and 2 were presented in the May 1994 Group II CMS/FS Report (BB&L 1994a). The CMS/FS activities for the Group III impoundments were summarized in the May 1995 Group III CMS/FS Report (BB&L 1995). These reports presented LTTT and bioremediation as the most appropriate remedial technologies for the respective impoundments. This was based on laboratory studies showing that the technologies were effective in treating the impoundment materials to meet TCLP levels. Final placement of treated residuals would be into Impound 8 which would be designated as a CAMU. Impound 8 is an on-site permitted hazardous waste management facility. In a letter dated September 11, 1995 (Shah 1995) (Exhibit A), the NJDEP and USEPA determined that TCLP levels were inappropriate to use as treatment objectives. For this reason, Impoundments 1 and 2 were transferred to Group III, and the May 1995 Group III CMS/FS Report was voided pending the results of further field scale treatability studies to identify appropriate, achievable treatment objectives for Impoundments 1 and 2 and the original Group III impoundments.

The NJDEP requested that Cyanamid use the treatability studies to determine if land disposal restriction (LDRs) or Superfund Guidance #6A (2nd Edition) "Obtaining a Soil and Debris Treatability Variance for Remedial Actions" variance levels could be achieved. The treatability testing demonstrated that the technologies were not consistently successful in achieving LDRs or the variance levels.

9/97 #3

However, it has been recognized by the NJDEP and USEPA that designation of Impound 8 as a CAMU for placement of impoundment materials may be appropriate for the site. Therefore, treatment objectives for the Group III impoundments have been developed based on the assumption that Impound 8 will be designated as a CAMU. ~~and LDRs and Superfund Guidance #6A variance levels are not applicable.~~ If a CAMU is not obtained, incineration is the only treatment technology which can meet LDRs or Superfund Guidance #6A variance levels. Impound 8 is a state-of-the-art, permitted waste management facility. The use of Impound 8 as a CAMU provides for long-term effectiveness of remedial actions by eliminating the migration of constituents to air, soil, ground water and surface water.

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The HSWA Part B Permit for the Impound 8 Facility was issued jointly by the NJDEP and USEPA Region II in 1988. A Class III HSWA permit modification was issued in March 1994 and is in effect until March 4, 1999. The Class III HSWA permit modification, combined with the operating permit issued by NJDEP, comprise the facility Resource Conservation and Recovery Act (RCRA) permit. The permit designates the Impound 8 Facility as a hazardous waste management facility, and specifies design and operating requirements for the facility.

According to the National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (NCP), "The purpose of the remedy selection process is to implement remedies that eliminate, reduce, or control risks to human health and the environment" (NCP §300.430(a)(1)). Disposal of materials from the Group III Impoundments into Impound 8 will accomplish this goal by essentially eliminating the potential for human or ecological exposure to hazardous substances that are present in the Group III impoundment material. The design

9/97 #4

under CERCLA and the requirements of the 1988 ACO, as amended. This report satisfies Paragraphs II.D.23 and II.D.25 of the ACO for Impoundments 1, 2, 3, 4, 5, 14, 20, and 26. As defined in Paragraph VI.13.C of the Findings Section of the ACO - *Facility Remediation Goals*, Cyanamid was required to investigate, evaluate, and implement corrective actions for the solid waste management units (SWMUs) on-site.

Two previously approved CMS/FS Reports, dated October 1992 [Record of Decision (ROD) signed September 1993] and November 1993 (amended May 1994)[ROD signed July 1996], address Group I and Group II, respectively (BB&L 1992b and BB&L 1994a). It should be noted that Group I originally included Impoundment 20. However, this impoundment was incorporated into Group III by the agencies during the Group I remedy selection process. As discussed in Section 1.1, Impoundments 1 and 2 were originally part of Group II, but were moved to Group III in order to incorporate supplemental treatability testing results. The Group I, Group II, and Group III CMS/FS reports present the recommended remedial alternatives for the sixteen CERCLA impoundments identified in the ACO. Remaining operable units to be addressed include site-wide soils and, if necessary, ground water at the site.

The history of the Bound Brook site has been reported in numerous documents prepared for the regulatory agencies. Section 2 of this report provides a limited site history. The reader is referred to either the Group I or Group II CMS/FS reports (BB&L 1992b and BB&L 1994a) or the CMS/FS Work Plan (BB&L 1991a) for a more detailed history of the site. The following background discussion addresses only the impoundment program to place this study into context with the overall site remedial program.

In November 1988, an Impoundment Characterization Program Sampling and Analysis Work Plan for thirteen of the on-site impoundments (Impoundments 1, 2, 3, 4, 5, 13, 14, 15, 16, 17, 18, 19, and 24) was submitted to the NJDEP and USEPA (BB&L 1989a). The work plan was amended, and approved in April 1989. In February 1989, a Work Plan for investigation of the three remaining impoundments required to be addressed by the 1988 ACO, as amended, (Impoundments 11, 20, and 26) was submitted to the NJDEP and the USEPA; this Work Plan was subsequently approved and made part of the overall sampling and analysis work plan in August 1989. In May 1989, the characterization program for the sixteen impoundments was implemented.

The results from sampling and analyses of the impoundment contents during implementation of the impoundment characterization program were compiled into an extensive database regarding the physical and chemical characteristics of the impoundments. This information was presented in the August 1990 Impoundment Characterization Program Final Report pursuant to the requirements of Paragraphs II.B.18 and II.D.22 of the 1988 ACO, as amended (BB&L 1990). Using this information, potentially applicable remedial technologies for each of the impoundments were identified and presented in the approved May 1991 Impoundment CMS/FS Work Plan (BB&L 1991a). The Work Plan satisfied the requirements of Paragraphs II.D.23 and II.D.25 of the 1988 ACO, as amended, and assisted in screening the "universe" of technologies to arrive at a more manageable number of technologies considered to be most applicable to the Group III impoundments. The technologies that were retained were fuel blending/recycling, LTTT, bioremediation, solidification, in-place containment (IPC), and incineration. The following information was used in the CMS/FS screening process:

- Data generated during the impoundment characterization program
- Results of a preliminary screening of remedial technologies described in Section 4.3 of the CMS/FS Work Plan (BB&L 1991a)
- Information generated during laboratory treatability and pilot-scale studies performed for Cyanamid on impoundment waste materials
- Information generated during vendor studies on impoundment materials.

NJDEP provided comments on the May 1995 Group III CMS/FS Report (BB&L 1995) in a letter dated September 11, 1995 (Exhibit A). In this letter, the NJDEP documented its decision to move Impoundments 1 and 2 from Group II into Group III because of the need to develop specific objectives for the recommended treatment technologies for these impoundments. The NJDEP declared the May 1995 Group III CMS Report void and required redevelopment and submittal of a CMS/FS Report for the new Group III impoundments to provide these recommended treatment objectives based on the results of the 1995 and 1996 treatability studies and other information.

Predesign testing of LTTT for Impoundments 1 and 2 was conducted in 1995 and 1996 in accordance with the Impoundments 1 and 2 Predesign Testing Work Plan (O'Brien & Gere 1995a). Field pilot testing of biotreatment for Impoundments 3, 4, 5, 14, 20, and 26 was conducted in 1995 and 1996 in accordance with the Solid Phase Evaluation Field Pilot Test for Biotreatment of Group III Impoundments Work Plan (O'Brien & Gere 1995b). The results of these supplemental treatability tests are documented in reports presented in Appendices A and B.

An initial version of the redeveloped Group III CMS/FS Report was submitted to NJDEP on April 30, 1996. NJDEP provided comments on this report in letters dated July 15, 1996 (Shah 1996a), November 25, 1996 (Shah 1996b), April 17, 1997 (Shah 1997a), ~~and~~ June 3, 1997 (Shah 1997b) and September

30, 1997 (Shah 1997c). AHPC provided responses in letters dated September 13, 1996 (Caracciolo, 1996), January 30, 1997 (McDonald, 1997a), and May 2, 1997 (McDonald, 1997b). These letters are included in Exhibit B. This report incorporates revisions based on this set of correspondence.

1.3. Project scope and report organization

The overall organization of this report is consistent with the CERCLA FS process. Report sections are organized as follows:

- Section 1 presents an overview of the project scope and objectives, as well as the regulatory status.
- Section 2 includes summaries of the site history, impoundment characterization data, geology and hydrogeology, surface water hydrology, the Baseline Endangerment Assessment, and the Natural Resources Assessment .
- Section 3 presents the identification and screening of technologies for the Group III impoundments. It also includes the remedial action objectives (RAOs), general response actions, volumes and types of media, and descriptions of potentially applicable technologies.
- Section 4 presents the evaluation of potentially applicable technology process options with respect to effectiveness, implementability.
- Section 5 discusses the development of protective and achievable treatment objectives based on risk-analysis and pilot-scale treatability study results.
- Section 6 incorporates the recommended treatment objectives in the development of alternatives for the Group III impoundment materials and includes a detailed description of each remedial alternative.
- Section 7 identifies potentially applicable or relevant and appropriate requirements (ARARs).
- Section 8 documents the detailed analysis of alternatives for the Group III impoundment materials with respect to the following evaluation criteria:
    - overall protection of human health and the environment
    - compliance with ARARs
    - long-term effectiveness and permanence
    - reduction of toxicity, mobility, or volume through treatment

- short-term effectiveness
- implementability
- cost
- regulatory agency acceptance
- community acceptance

- Section 9 presents the recommended remedial alternatives and implementation schedule for the Group III impoundment materials.

Compound Compounds of Concern	Initial Conc. (mg/kg)	Minimum Treatment Level					Max. of Minimum	Overall Average[1]	Overall Std. Dev.[1]
		I-4	I-5	I-14	I-20	I-26			
Benzene	21,000	1.20	1.09	1.78	0.610	0.001	1.78	2.49	2.98
Toluene	3,100	0.759	2.84	2.80	0.187	0.008	2.84	4.94	7.89
Xylene (total)	5,500	1.18	3.63	2.00	50.900	0.007	50.9	30.5	52.0
Naphthalene	240,000	250	3360	2850	9.17	9.59	3360	3490	5024
Nitrobenzene	8,500	3.80	71.8	1850	4.30	4.47	1850	517	981
1,2-Dichlorobenzene	1,700	77.7	20.4	4.37	1.37	11.7	77.7	48.5	70.0
N-Nitrodiphenylamine	21,000	14.8	967.00	6390	17.6	6.61	6390	1878	3340
2-Methylnaphthalene	9,200	61.0	591.00	309	3.80	3.42	591.00	299	377

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Note: (1) Refer to Appendix F for basis of calculation.

Based on this data and the statistical analysis, a biological treatment time frame of three to nine weeks and the associated minimum treatment levels have been identified as being appropriate for determining achievable treatment objectives for the Group III impoundment materials. These levels sufficiently enhance the protectiveness of the remedial alternatives which, with final placement into Impound 8, already meet the remedial action objective. Additional treatment beyond this timeframe does not provide sufficient additional concentration or risk reduction, as demonstrated through the statistical analysis, to justify its use. The benefits potentially derived from further enhancements beyond that associated with the pilot study treatment timeframe is substantially less than the additional costs of the unwarranted treatment. For this reason, the minimum concentration data sets associated with the three to nine week biological treatment timeframes will be utilized in developing the achievable treatment objectives.

5.2.3. Low temperature thermal treatment

LTTT was identified as being a potential remedial technology for Impoundments 1 and 2. For this reason, Cyanamid conducted various treatability studies using the LTTT technology. The initial treatability studies used TCLP standards as a benchmark. NJDEP advised Cyanamid that TCLP standards were not relevant. Instead, NJDEP required that Cyanamid conduct further LTTT studies to assess performance treatment levels. Appendix A presents the results of these studies.

A major focus of the low temperature pilot program was to develop a comparable database of achievable LTTT levels by providing a consistent raw

Compounds of Concern	Max. Initial Conc. (mg/kg)	Min 2VR-1	Min 2MIX-1	Min 2HC-1	Min 1MIX-1	Max of Min	Overall Avg.(1)	Overall Std Dev(1)
Benzene	61,000	0.0068	0.17	0.243	0.118	0.243	2.67	5.15
Toluene	16,200	0.0065	0.424	0..323	0.0408	0.424	7.88	19.9
Xylenes (total)	3,440	0.001	0.0855	0.219	0.0167	0.219	5.18	6.98
Naphthalene	9,860	0.053	1.50	0.885	0.448	1.5	159	204
Nitrobenzene	1,330	0.05	1.30	1.4	1.20	1.40	5.20	9.39
1,2-Dichlorobenzene	2,210	0.05	0.793	1.06	1.40	1.40	19.70	18.1
N-Nitrosodiphenylamine	<5.5	0.023	0.61	0.65	0.57	0.65	0.608	0.141
2-Methylnaphthalene	1,520	0.043	0.617	0.424	0.535	0.617	19.2	22.8

Note: (1) Refer to Appendix F for basis of calculation.

9/97 #5

Based on this data and the statistical analysis, a range of LTTT operating conditions has been selected as the performance basis for evaluating this technology for the Group III impoundment material. This range included temperatures of 300°F - 800°F and retention times of 10 - 25 minutes. Within the pilot study, certain data were obtained from processes that were outside of the LTTT operating range considered appropriate for this material. These processes, which were not included in the evaluation, included Soil tech's ATP system (which approximates incineration) and certain Weston operating conditions which were below 300°F. Outside the operating range does not increase the enhancement of the remedial alternatives' ability to meet the RAO proportional to the associated additional costs. Therefore, it is consistent with CMS/FS guidance to exclude these operating conditions in evaluating LTTT alternatives.

5.3. Treatability scale-up factors

As discussed in Section 5.2, both the bioremediation and LTTT can significantly reduce constituent concentrations associated with Group III materials prior to their placement into Impound 8. Treatment and associated compound reduction enhances the protectiveness of the remedial alternatives. The removal efficiency, and the ability to analytically demonstrate the consistency of that removal, is dependent on several variables including:

- the consistency of material

utilized to determine appropriate, consistently achievable treatment objectives.

The USEPA and NJDEP also requested an evaluation of the biotreatment levels relative to removal efficiencies. This was accomplished by summarizing the structural/functional groups to obtain each group's overall removal efficiency. The summary of the results is provided below. The complete analysis is provided in Appendix G.

Biotreatment structural/functional grouping analysis (Impoundments 4, 5, 14, 20 and 26)

Structural/ Functional Group	Feed Treatability Data (mg/kg)	6A Variance Percent Reduction Rate	Treatment Level (1) (mg/kg)	Percent Reduction
Non-polar Aromatics	21,000	90 - 100	54	99.7%
Halogenated Non-polar Aromatics	4,860	90 - 99.9	1,570	67.7%
Halogenated Phenols	18,200	90-99	1,315	92.8%
Halogenated Aliphatics	21,840	95-99.9	394	98.2%
Halogenated Cyclics	9.200	90 - 99.9	905	90.2%
Nitrated Aromatics	41,300	99.9 - 99.99	4,630	88.8%
Polynuclear Aromatics	266,270	95 - 99	17,315	93.5%
Other Polar Organics	57,350	90 - 99	14,040	75.5%

9/97#6

Note:
(1) Derived from the average treatment cbjectives, as defined in Section ~~5.7.~~ 5.6 and Appendix F

As can be seen from the above, biotreatment achieves percent reductions that are within the acceptable 6A ranges for four of the eight structural/functional groups. Greater than 90% removal is realized for five structural/functional groups. When the mass of material categorized in these groups is summed, it represents over 95% of the regulated compounds in the waste material. Of those four structural/functional groups which do not meet the 6A ranges, one of the percent reductions is over 90% and the remainder are over 75% of their target values. This further supports biotreatment as the appropriate treatment technology for this material, given its treatment effectiveness for the regulated compounds.

~~Based on the heterogeneity of the materials the monitoring period for average compliance is proposed as six months. The frequency of monitoring for maximum treatment objectives will be established during the remedial design phase of this program. Sampling will be performed during initial raw material characterization, after treatment, and prior to final placement in Impound 8.~~

Based on the heterogeneity of the material, the monitoring period for average compliance is proposed as six months. The frequency of monitoring for maximum treatment objectives will be established during the remedial design phase of this program. However, it should be noted that the maximum treatment objectives represent the maximum values obtained during any sampling day (i.e., a daily maximum). Sampling will be performed during initial raw material characterization, after treatment and prior to final placement in Impoundment 8.

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The proposed treatment objectives, as defined above, are as follows:

Biotreatment (Impoundments 4, 5, 14, 20 and 26)

Compound of Concern	Average Treatment Objective (mg/kg)	Maximum Treatment Objective (mg/kg)
Benzene	54	60
Toluene	145	145
Xylene	180	230
Naphthalene	12,000	13,100
Nitrobenzene	3,360	5,200
1,2-dichlorobenzene	250	320
N-nitrosodiphenylamine	12,000	14.300
2-methylnaphthalene	1,760	1,900

LTTT (Impoundments 1, 2, and 3)

Compound of Concern	Average Treatment Objective (mg/kg)	Maximum Treatment Objective (mg/kg)
Benzene	85	85
Toluene	200	200
Xylene	115	115

9/97 #8

6.4.2. Alternative D2 - bioremediation with final placement in Impound 8

Alternative D2, solid-phase bioremediation, involves treatment of the material using solid-phase bioremediation and placement of the treated materials in the Impound 8 facility. A conceptual treatment train is provided in Figure 6-4.

Material handling. The Category D material would be removed from the impoundments using standard excavation techniques, such as long-reach excavator, backhoe, or clamshell and crane. The excavation would include 6 inches of soil beneath the impoundment materials. Debris would be separated from the impoundment materials. Section 6.5.2. provides a detailed discussion for the debris handling. Excavated material may be placed in a temporary staging area. The staging area will have appropriate air emission monitoring, control, and treatment as necessary.

Treatment. Biological processing using modified compost or aerated pile techniques would be used for treatment. Compost process alternative include:

- forced air assisted windrow composting
- forced air assisted solid phase continuous flow composting

In each case, aeration would be provided by subgrade collection ducts drawing air from the atmosphere through the impoundment materials for treatment and discharge. Windrow mixing would typically be provided by a straddle-type tiller, while the continuous mixing provides a mechanical tiller that tracks along bay walls containing the treatment medium. In the latter case, material to be treated is also moved forward a pre-determined distance allowing material to be added at the feed end and removed at the opposite end. Moisture and nutrient levels would be monitored and maintained, as necessary, based on the results of the pre-design testing. Biological treatment using indigenous microorganisms with a treatment duration of 21 days is anticipated. A portion of the finished compost may be recycled to the feed, however, to reduce acclimation or lag time. Finished compost may be cured in passive piles if additional polishing is required.

The treated material would be post-conditioned, for the purpose of strength conditioning, as necessary to achieve unconfined compressive strength requirements for final disposal in the Impound 8 facility, and as needed to meet TCLP limits for metals. Post-conditioning would involve the addition of stabilizing agents as Portland cement, sodium silicate, and moisture.

During the remedial design, the viability of utilizing the category D material as an admixture for other material categories will be addressed.

Long-term effectiveness and permanence. Alternative A1 would provide for future limitation of contact through fencing and land use restrictions and for minimizing potential risks associated with VOC emissions via water covers/liners. Each of these measures is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents remain since the high Btu tar would remain in-place within the impoundments. Alternative A1, therefore, would not provide long-term effectiveness. Alternatives A2, A3, and A4 would provide long-term effectiveness by minimizing residual risk through removal, solidification for strength and reduction of metals leachability, and containment of the high Btu tars in the Impound 8 facility. Each of these measures is an adequate and reliable method for minimizing human exposure and minimizing migration of the tar constituents. Alternatives A3 and A4 would further minimize human exposure and enhance long-term effectiveness through treatment with Alternative A4 providing increased long-term effectiveness with the highest degree of contaminant removal through incineration. Alternatives A3 and A4 would permanently reduce the levels of contaminants that are present in the impoundment materials.

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Reduction of toxicity, mobility, or volume through treatment. Alternative A1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternative A2 (consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in Impound 8. A slight material volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternative A3 (LTTT) offers a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. A net material volume increase of 25% is expected due to pre-LTTT conditioning and post-LTTT conditioning with admixtures. Alternative A4 offers the greatest reduction in containment mass and toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net material volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative A4 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through incineration. Alternatives A3 and A4 would permanently reduce the levels of contaminants that are present in the impoundment materials.

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Short-term effectiveness. Alternative A1 would provide for short-term effectiveness through limitation of contact with the high Btu tar through fencing and land use restrictions. The water cover/liner would also limit contact with the material by limiting VOC emissions from Impoundments 1 and 2. However, the material within these Impoundments would continue action contract and by maintaining compliance with those requirements through remedial action monitoring. Each of Alternatives B1, B2, B3, B4, and B5 would meet the location-specific ARARs.

Action-specific ARARs identified for Alternatives B1, B2, B3, B4, and B5 include the 1988 ACO, NJDEP Technical Requirements for Site Remediation (NJAC 7:26E et. seq.) and OSHA regulations. These ARARs would be met through specifying the substantive requirements in the remedial action contract and by monitoring compliance during inspection activities. Additional action-specific ARARs would be triggered for Alternatives B2, B3, B4 and B5 due to material excavation, conditioning and/or treatment, and placement in Impound 8. These ARARs would include New Jersey SESC requirements; New Jersey Hazardous waste regulations related to residual waste disposal; DOT transport requirements; and RCRA regulations pertaining to Impound 8. These ARARs would also be met through specification of the substantive requirements in the remedial action contract documents and during remedial action monitoring to maintain compliance. Each of Alternatives B2, B2, B3, B4, and B5 would meet the action-specific ARARs.

Long-term effectiveness and permanence. Alternative B1 would provide for future limitation of contact with low Btu tar/sludge through site controls and land use restrictions and for minimizing potential risks associated with VOC emissions via water covers. Each of these measures is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents to the soil and ground water remain since the low Btu value tar/sludge would remain in-place within the impoundments. These components, therefore, would not provide long-term effectiveness for Alternative B1. Alternatives B2, B3, B4, and B5 would provide long-term effectiveness by minimizing residual risk through removal, solidification for strength and reduction of metals leachability, and containment of the low Btu tar/sludge in the Impound 8 facility. Each of these measures is an adequate and reliable method for minimizing human exposure and minimizing migration of the tars constituents. Alternatives B3, B4, and B5 would further minimize human exposure and enhance long-term effectiveness through treatment with Alternative B5 providing increased long-term effectiveness with the highest degree of contaminant removal through incineration. Alternatives B3, B4 and B5 would permanently reduce the levels of contaminants that are present in the impoundment material.

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Reduction of toxicity, mobility, or volume through treatment. Alternative B1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternative B2 (consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in Impound 8. A slight volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternatives B3 and B4 (bioremediation and LTTT) offer a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. Alternative B3 would have a net material volume increase of approximately 200% due to required pre- and post-conditioning. A net material volume increase of 25% is expected for Alternative B4 due to pre-LTTT conditioning and post-LTTT conditioning with admixtures. Alternative B5 (incineration) offers the greatest reduction in contaminant mass and toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net material volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative B5 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through incineration. Alternatives B3, B4, and B5 would permanently reduce the levels of contaminants that are present in the impoundment material.

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Short-term effectiveness. In each alternative, the community would be restricted from access to the site during remediation through locking gates currently in-place and an existing manned guardpost. Alternative B1, no action/institutional actions, would provide for limitation of contact with the low Btu tar/sludge through site controls and land use restrictions. The water covers at Impoundments 4, 5 and 14 would also limit contact with the material by limiting VOC emissions from those impoundments. There would be no anticipated impacts to the community from ground water monitoring associated with this alternative. Appropriate protective equipment would be used during monitoring activities in Alternative B1 and in remedial activities in Alternatives B2, B3, and B4. Appropriate mitigation measures would be implemented to control vapor emissions during excavation and treatment of the low Btu tar/sludge in Alternatives B2, B3, and B4. With respect to Alternatives B2, B3, and B4, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts. The use of appropriate controls would therefore provide for equivalent short-term effectiveness with respect to human health in each alternative. Alternatives B2, B3, B4 and B5 would provide for equivalent short-term effectiveness with respect to the environment with appropriate controls, while environmental impacts would not be minimized in Alternative B1 since migration of constituents to the ground water would continue for the in-place material.

With respect to the RAO, Alternative B1 would not provide for minimization of migration of constituents to the air, soil, or ground water. Alternatives B2, B3, B4, and B5 would achieve the RAO upon completion. Alternative B2 would achieve the RAO in a timeframe of 1 to 2 yrs.

to maintain compliance. Each alternative would meet the action-specific ARARs.

Long-term effectiveness and permanence. Alternative C1 would provide for future limitation of contact with Impoundment 3 materials through site controls and land use restrictions Each of these is an adequate and reliable control for limiting human contact; however, the potential risks associated with migration of constituents to the ground water remain since the material would remain in-place within Impoundment 3. These components, therefore, would not provide long-term effectiveness. Alternatives C2, C3, and C4, would provide long-term effectiveness by minimizing residual risk through removal, solidification for strength and reduction of metals leachability, and containment of the Impoundment 3 material in Impound 8. Each of these measures is an adequate and reliable method for minimizing human exposure and minimizing migration of the Impoundment 3 constituents and would provide long-term effectiveness. Alternatives C3 and C4 would further minimize human exposure and enhance long-term effectiveness through treatment with Alternative C4 providing increased long-term effectiveness with the highest degree of contaminant removal through incineration.. Alternatives C3 and C4 would permanently reduce the levels of contaminants that are present in the impoundment material.

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Reduction of toxicity, mobility, or volume through treatment. Alternative C1 does not include any removal or treatment; and therefore, offers no reduction of toxicity, mobility, or volume.- Alternative C2 would provide for a reduction in mobility through solidification and placement in Impound 8. A slight material volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternative C3 offers a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction of mobility is provided through placement in Impound 8. Alternative C3 would result in approximately 30% net material volume increase due to pre-LTTT and post-LTTT conditioning with admixtures. Alternative C4 offers the greatest reduction in contaminant mass and toxicity due to material destruction in order to meet UTS or 6A variance levels. Mobility would again be reduced due to placement in Impound 8. A net material volume decrease of approximately 80% is expected due to material conversion into gaseous products of combustion. Alternative C4 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through incineration. Alternatives C3 and C4 would permanently reduce the levels of contaminants that are present in the impoundment material.

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Short-term effectiveness. Alternative C1 would provide for limitation of contact with the Impoundment 3 material through site controls and land use restrictions. There would be no anticipated impacts to the community from

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minimizing migration of the constituents, and would provide long-term effectiveness, with Alternative D2 providing, increased long-term effectiveness with the highest degree of contaminant removal through bioremediation. Alternative D2 would permanently reduce the levels of contaminants that are present in the impoundment material.

Reduction of toxicity, mobility, or volume through treatment. Alternative D1 (no action/institutional controls) does not include any removal or treatment and therefore, offers no reduction of toxicity, mobility, or volume. Alternatives D3 and D4 (off-site disposal and consolidation in Impound 8) would provide for a reduction in mobility through solidification and placement in an off-site landfill or Impound 8. A slight material volume increase (approximately 10%) is expected due to the addition of conditioning admixtures. Alternative D2 (bioremediation) offers a greater reduction in contaminant mass and toxicity through active treatment to meet the CAMU treatment objectives. A reduction in mobility is provided through placement in Impound 8. Alternative D2 would have a net material volume increase of approximately 200% for Impoundment 5 material and 100% for Impoundment 26 material due to required pre- and post-conditioning. Alternative D2 would provide the highest reduction of toxicity, mobility, and volume with the highest degree of contaminant removal through bioremediation. Alternative D2 would permanently reduce the levels of contaminants that are present in the impoundment material.

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Short-term effectiveness. Alternative D1 would provide for limitations of contact with the non-hazardous material through site controls and land use restrictions. There would be no anticipated impacts to the community from ground water and tar seep monitoring associated with this alternative. In Alternatives D2, D3, and D4, the community would be restricted from access to the site during remedial activities through locking gates currently in-place and an existing manned guardpost. Appropriate protective equipment would be used during monitoring activities in Alternative D1 and in remedial activities for Alternatives D2, D3, and D4. Appropriate mitigation measures would be implemented to control vapor emissions during excavation of the non-hazardous material in Alternatives D2, D3, and D4. With respect to Alternatives D2, D3, and D4, appropriate mitigation measures would be used during remedial activities to minimize environmental impacts. The use of appropriate controls would threfore provide an equivalent level of short-term effectiveness with respect to human health in each alternative. Alternatives D2, D3, and D4 would provide for equivalent short-term effectiveness with respect to the environment with appropriate controls while, environmental impacts would not be minimized in Alternative D1, since migration of constituents to the ground water could continue of the in-place material.

General plant debris. Separate from other impoundment material; separate residual surface sludge for treatment, size as appropriate for consolidation into the Impound 8 facility.

These alternatives reflect a balance between treating the contents of the impoundments that contain hazardous material to achievable, risk-supported treatment objectives prior to consolidation in Impound 8, and consolidating without treatment the non-hazardous material. The characterization and pilot studies demonstrated that Impoundments 1, 2, 3, 4, 5 (wet), 14, and 20 contain elevated concentrations of hazardous constituents which represent a continuing source of ground-water contamination. In contrast, Impoundments 5 (dry) and 26 contain "landfill-like" materials, are non-hazardous, and have sufficient bearing strength "as is" based on the solidification bench-scale test results. Thus, the recommended remedy reflects a balance between removing and treating certain impoundment materials to prevent future adverse impacts to ground water, and removing other material that are not classified as a characteristic hazardous waste. Both components make use of the on-site Impound 8 facility to consolidate the treated and untreated materials. This added layer of protection is fundamental to the permanence of this remedy.

9.3 Justification for the recommended alternatives

The following reasons provide the basis for selecting the recommended alternatives:

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- Bioremediation would ~~remove~~ be effective in reducing the compounds of concern ~~as effectively as the thermal treatment options~~ for material category B

- The site is suited to bioremediation (for category B) because the existing bacteria are already acclimated to the waste materials, and have been shown in the laboratory and during the pilot study to satisfactorily degrade the compounds of concern

- LTTT and bioremediation combination provide flexibility in remediating the wide variety of heterogeneous material within the Group III impoundments

- LTTT will be used to achieve Group III treatment objectives for materials that are not amenable to bioremediation

- The combination of bioremediation and LTTT is more cost-effective, yet provides a comparable level of protection.

Final disposition of all material will be in Impound 8, a permitted, triple-lined waste management facility.

9.4. Impound 8 contingencies

A contingency plan is proposed in the event that contaminants and/or leakage is detected below the secondary liner system of Impound 8. The plan will include monitoring of the subsurface drainage system, which is located beneath the tertiary liner, in the event that leachate is present within the leachate detection system at levels greater than the Action Leakage Rate specified in the regulations. The existing Impound 8 Preparedness and Prevention Plan, and Program Contingency Plan will be modified to include the proposed components. In the event that leachate is detected beneath the tertiary liner, a ground water containment/collection program will be implemented. This program would include the installation of a ground water extraction system at the Impound 8 facility. Plans and sections of the Impound 8 facility are shown in Figure 9-1.

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9.5. Schedule

The proposed schedule for implementing the recommended alternative is illustrated in Figure 9-~~1~~2. This schedule has been developed with the understanding that site-wide implementation of multiple investigatory and remedial activities is ongoing. The extent of remedial efforts underway at the site, and the logistics of completing certain activities prior to initiation of other activities, require careful scheduling considerations. The proposed schedule differs from previous schedules submitted to the agencies in that it is presented on a quarterly basis and, more importantly, that it shows the importance of coordinating the Group III remedial activities with the Impound 8 facility program and those portions of the Groups I and II remedial activities which may impact Group III work, and vice-versa. The components presented in Figure 9-1 reflect a schedule based on current projections. A more precise schedule for remediation of the Group III Impoundments will be provided in the Remedial Design Report for these impoundments.

APPENDIX G

UTS and UTS variance comparison

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AMERICAN HOME PRODUCTS CORPORATION
Bound Brook, NJ Facility

Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
COMPOUNDS OF CONCERN							
benzene	61,000	100	0.5 - 10	90 - 99.9	61 - 6100	85	10
toluene	16,200	100	0.5 - 10	90 - 99	162 - 1620	200	10
xylenes (total)	3,440	100	0.5 - 10	90 - 99	34 - 344	115	30
naphthalene	* 11,000	400	0.5 - 20	95 - 99	110 - 550	670	5.6
nitrobenzene	***1,330***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***165***	***14***
1,2-dichlorobenzene	* 6,100	200	0.5 - 20	90 - 99.9	6.1 - 610	200	6
N-nitrosodiphenylamine	150	100	0.5 - 10	90 - 99	2 - 15	5	13
2-methylnaphthalene	**** 1,520***	***400***	***0.5 - 20***	***95 - 99***	***15 - 76***	***200***	***7***
HALOGENATED NON-POLAR AROMATICS		***100***	***0.5 - 10***	***90 - 99.9***			
1,4-dichlorobenzene	* 1,200	100	0.5 - 10	90 - 99.9	1.20 - 120	30	6
hexachlorobenzene	< 180	100	0.5 - 10	90 - 99.9	0.18 - 18	15	10
1,2,4-trichlorobenzene	70	100	0.5 - 10	90 - 99.9	0.50 - 10	10	19
HALOGENATED PHENOLS		***400***	***0.5 - 40***	***90 - 99***			
4-chloroaniline	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	15	16
2-chlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	25	5.7
4-chloro-3-methylphenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	25	14
2,4-dichlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	30	14
pentachlorophenol	*< 890	400	0.5 - 40	90 - 99	8.90 - 89	30	7.4
2,4,5-trichlorophenol	*< 890	400	0.5 - 40	90 - 99	8.90 - 89	25	7.4
2,4,6-trichlorophenol	*< 180	400	0.5 - 40	90 - 99	0.5 - 40	20	7.4
HALOGENATED ALIPHATICS		***40***	***0.5 - 2***	***95 - 99.9***			
bromodichloromethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	15
bromoform	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	5	15
bromomethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	2	15
carbon tetrachloride	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
chloroethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1	6
chloroform	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1	6
chloromethane	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	1	30
dibromochloromethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	15
1,1-dichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,2-dichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,1-dichloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
trans-1,2-dichloroethylene	< 280	40	0.5 - 2	95 - 99.9	0.28 - 14	1	30
1,2-dichloropropane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	18

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
cis-1,3-dichloropropene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	18
trans-1,3-dichloropropene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	18
hexachlorobutadiene	****< 180***	***40***	***0.5 - 2***	***95 - 99.9***	***0.2 - 9***	***10***	***5.6***
hexachloroethane	****< 180***	***40***	***0.5 - 2***	***95 - 99.9***	***0.2 - 9***	***20***	***30***
methylene chloride	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	30
1,1,2,2-tetrachloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	5	6
tetrachloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,1,1-trichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
1,1,2-trichloroethane	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
trichloroethylene	*< 1,100	40	0.5 - 2	95 - 99.9	1.10 - 55	1	6
vinyl chloride	*< 2,100	40	0.5 - 2	95 - 99.9	2.10 - 105	2	6
HALOGENATED CYCLICS		***200***	***0.5 - 20***	***90 - 99.9***			
chlorobenzene	*< 1,100	200	0.5 - 20	90 - 99.9	1.1 - 110	1	6
2-chloronaphthalene	***378***	***200***	***0.5 - 20***	***90 - 99.9***	***0.4 - 37.8***	***50***	***5.6***
1,3-dichlorobenzene	* 190	200	0.5 - 20	90 - 99.9	0.50 - 20	10	6
hexachlorocyclopentadiene	< 180	200	0.5 - 20	90 - 99.9	0.50 - 20	20	2.4
NITRATED AROMATICS		***10,000***	***2.5 - 10***	***99.9 - 99.99***			
4,6-dinitro-o-cresol	****< 890***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***30***	***160***
2,4-dinitrotoluene	****< 63***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***20***	***140***
2,6-dinitrotoluene	****< 180***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***15***	***28***
2-nitroaniline	****< 890***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***15***	***14***
3-nitroaniline	****< 890***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***15***	***14***
4-nitroaniline	****< 890***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***10***	***28***
2-nitrophenol	****< 180***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***35***	***13***
4-nitrophenol	****< 890***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***50***	***29***
POLYNUCLEAR AROMATICS		***400***	***0.5 - 20***	***95 - 99***			
acenaphthene	****< 180***	***400***	***0.5 - 20***	***95 - 99***	***0.5 - 20***	***90***	***3.4***
anthracene	****< 180***	***400***	***0.5 - 20***	***95 - 99***	***0.5 - 20***	***55***	***3.4***
benzo(a)anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	3.4
benzo(a)pyrene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	3.4
benzo(b)fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	6.8
benzo(g,h,i)perylene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5	1.8
benzo(k)fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	20	6.8
chrysene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5	3.4
dibenzo(a,h)anthracene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	10	8.2

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Low Temperature Thermal Desorption -- Material Category A

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
fluoranthene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	15	3.4
fluorene	**** 2,800***	***400***	***0.5 - 20***	***95 - 99***	***28.0 - 140***	***200***	***3.4***
indeno(1,2,3-cd)pyrene	*< 180	400	0.5 - 20	95 - 99	0.5 - 20	5	3.4
phenathrene	** 360*	*400*	*0.5 - 20*	*95 - 99*	*0.5 - 20*	*50*	*5.6*
pyrene	* 40	400	0.5 - 20	95 - 99	1 - 20	10	8.2
OTHER POLAR ORGANICS		*100*	*0.5 - 10*	*90 - 99*			
acetone	< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	15	160
benzoic acid	884	100	0.5 - 10	90 - 99	8.8 - 88.4	80	8
bis(2-chloroethoxy) methane	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	15	7.2
bis(2-chloroethyl)ether	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	6
bis(2-ethylhexyl)phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	28
4-bromophenyl phenyl ether	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	15
2-butanone	*< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	3	36
butyl benzyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	28
carbon disulfide	*< 1,100	100	0.5 - 10	90 - 99	11.00 - 110	2	4.8
diethylphthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	10	28
2,4-dimethylphenol	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	14
dimethylphthalate	*< 180	100	0.5 - 10	90 - 99	2 - 18	10	28
di-n-butyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	28
2,4-dinitrophenol	*< 890	100	0.5 - 10	90 - 99	8.90 - 89	65	160
di-n-octyl phthalate	*< 180	100	0.5 - 10	90 - 99	1.8 - 18	5	28
ethylbenzene	****< 1,100***	***100***	***0.5 - 10***	***90 - 99***	***11.0 - 110***	***200***	***10***
2-hexanone	*< 2,100	100	0.5 - 10	90 - 99	21.00 - 210	1	33
phenol	240	100	0.5 - 10	90 - 99	2.4 - 24	20	6.2

Notes: **Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.**

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Low Temperature Thermal Treatment field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used. Results indicated with "*" are drawn from the Impoundment 3 Bioremediation field pilot study.

(2) If compound analytical result is less than threshold value, then concentration range is shown.
(3) Other technologies may be used if treatability studies or other information indicates that they can achieve the necessary concentration of percent-reduction range.
(4) TCLP also may be used when evaluating material with relatively low levels of organics that have been treated through an immobilization process.
(5) Shown as the concentration range if the analtyical result is less than the threshold value, and as the percent reduction of the feed data if the analytical result is greater than the threshold value.
(6) Maximum treatment objectives calculated in accordance with Section 5.6 and Appendix F.

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AMERICAN HOME PRODUCTS CORPORATION
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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
COMPOUNDS OF CONCERN							
benzene	21,000	100	0.5 - 10	90 - 99.9	21 - 2100	60	10
toluene	3,100	100	0.5 - 10	90 - 99	31 - 310	145	10
xylenes (total)	5,500	100	0.5 - 10	90 - 99	55 - 550	230	30
naphthalene	***240,000***	***400***	***0.5 - 20***	***95 - 99***	***2400 - 12000***	***13,100***	***6***
nitrobenzene	***< 8,500***	***10,000***	***2.5 - 10***	***99.9 - 99.99***	***2.5 - 10***	***5200***	***14***
1,2-dichlorobenzene	1,500	200	0.5 - 20	90 - 99.9	1.5 - 150	320	6
N-nitrosodiphenylamine	***21,000***	***100***	***0.5 - 10***	***90 - 99***	***210 - 2100***	***14,300***	***13***
2-methylnaphthalene	***9,200***	***400***	***0.5 - 20***	***95 - 99***	***92.0 - 460***	***1900***	***7***
HALOGENATED NON-POLAR AROMATICS		***100***	***0.5 - 10***	***90 - 99.9***			
1,4-dichlorobenzene	***< 960***	***100***	***0.5 - 10***	***90 - 99.9***	***0.96 - 96***	***170***	***6***
hexachlorobenzene	< 1,200	100	0.5 - 10	90 - 99.9	1.20 - 120	100	10
1,2,4-trichlorobenzene	***2,700***	***100***	***0.5 - 10***	***90 - 99.9***	***2.70 - 270***	***1300***	***19***
HALOGENATED PHENOLS		***400***	***0.5 - 40***	***90 - 99***			
4-chloroaniline	< 1,200	400	0.5 - 40	90 - 99	12.0 - 120	115	16
2-chlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***5.7***
4-chloro-3-methylphenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***14***
2,4-dichlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***14***
pentachlorophenol	< 6,100	400	0.5 - 40	90 - 99	61.00 - 610	200	7.4
2,4,5-trichlorophenol	< 6,100	400	0.5 - 40	90 - 99	61.00 - 610	200	7.4
2,4,6-trichlorophenol	***< 1,200***	***400***	***0.5 - 40***	***90 - 99***	***12.0 - 120***	***200***	***7.4***
HALOGENATED ALIPHATICS		***40***	***0.5 - 2***	***95 - 99.9***			
bromodichloromethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	15
bromoform	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	3	15
bromomethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	15
carbon tetrachloride	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
chloroethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	6
chloroform	800	40	0.5 - 2	95 - 99.9	0.80 - 40	15	6
chloromethane	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	5	30
dibromochloromethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	1	15
1,1-dichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,2-dichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,1-dichloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
trans-1,2-dichloroethylene	-	40	0.5 - 2	95 - 99.9	0.50 - 2	5	30
1,2-dichloropropane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	18

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
cis-1,3-dichloropropene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	18
trans-1,3-dichloropropene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	3	18
hexachlorobutadiene	*< 1,200*	*40*	*0.5 - 2*	*95 - 99.9*	*1.20 - 60*	*100*	*5.6*
hexachloroethane	*< 1,200*	*40*	*0.5 - 2*	*95 - 99.9*	*1.20 - 60*	*165*	*30*
methylene chloride	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	30
1,1,2,2-tetrachloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	2	6
tetrachloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	25	6
1,1,1-trichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
1,1,2-trichloroethane	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
trichloroethylene	< 790	40	0.5 - 2	95 - 99.9	0.79 - 39.5	5	6
vinyl chloride	< 1,500	40	0.5 - 2	95 - 99.9	1.50 - 75	10	6
HALOGENATED CYCLICS		*200*	*0.5 - 20*	*90 - 99.9*			
chlorobenzene	4,100	200	0.5 - 20	90 - 99.9	4.1 - 410	200	6
2-chloronaphthalene	*< 1,200*	*200*	*0.5 - 20*	*90 - 99.9*	*1.20 - 120*	*200*	*5.6*
1,3-dichlorobenzene	< 1,200	200	0.5 - 20	90 - 99.9	1.20 - 120	70	6
hexachlorocyclopentadiene	*< 1,200*	*200*	*0.5 - 20*	*90 - 99.9*	*1.20 - 120*	*185*	*2.4*
NITRATED AROMATICS		*10,000*	*2.5 - 10*	*99.9 - 99.99*			
4,6-dinitro-o-cresol	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*160*
2,4-dinitrotoluene	*< 1,200*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*140*
2,6-dinitrotoluene	*< 1,200*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*125*	*28*
2-nitroaniline	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*125*	*14*
3-nitroaniline	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*135*	*14*
4-nitroaniline	*< 4,800*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*85*	*28*
2-nitrophenol	*< 1,200*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*13*
4-nitrophenol	*< 6,100*	*10,000*	*2.5 - 10*	*99.9 - 99.99*	*2.5 - 10*	*200*	*29*
POLYNUCLEAR AROMATICS		*400*	*0.5 - 20*	*95 - 99*			
acenaphthene	*1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*380*	*3.4*
anthracene	*560*	*400*	*0.5 - 20*	*95 - 99*	*5.6 - 28*	*210*	*3.4*
benzo(a)anthracene	*490*	*400*	*0.5 - 20*	*95 - 99*	*4.9 - 24.5*	*1000*	*3.4*
benzo(a)pyrene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*75*	*3.4*
benzo(b)fluoranthene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*65*	*6.8*
benzo(g,h,i)perylene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	60	1.8
benzo(k)fluoranthene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*125*	*6.8*
chrysene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*75*	*3.4*
dibenzo(a,h)anthracene	*< 1,200*	*400*	*0.5 - 20*	*95 - 99*	*12.0 - 60*	*85*	*8.2*

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Alternative Treatability Variance Levels and Technologies for Structural/Functional Groups Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	EPA Threshold Concentration (ppm)(2) Total Analysis (3)	EPA Concentration Range (ppm) Total Analysis (4)	Percent Reduction Range	Treatment Level (5)	Maximum Treatment Objective (6)	UTS
fluoranthene	***< 960***	***400***	***0.5 - 20***	***95 - 99***	***9.6 - 48***	***200***	***3.4***
fluorene	***3,200***	***400***	***0.5 - 20***	***95 - 99***	***32.0 - 160***	***650***	***3.4***
indeno(1,2,3-cd)pyrene	< 1,200	400	0.5 - 20	95 - 99	12.0 - 60	40	3.4
phenathrene	***1,300***	***400***	***0.5 - 20***	***95 - 99***	***13 - 65***	***390***	***5.6***
pyrene	***< 960***	***400***	***0.5 - 20***	***95 - 99***	***10 - 48***	***200***	***8.2***
OTHER POLAR ORGANICS		100	0.5 - 10	90 - 99			
acetone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	160
benzoic acid	-	***100***	***0.5 - 10***	***90 - 99***	***0.5 - 10***	***200***	***8***
bis(2-chloroethoxy) methane	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***125***	***7.2***
bis(2-chloroethyl)ether	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	85	6
bis(2-ethylhexyl)phthalate	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***28***
4-bromophenyl phenyl ether	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	75	15
2-butanone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	36
butyl benzyl phthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	30	28
carbon disulfide	< 790	100	0.5 - 10	90 - 99	7.90 - 79	5	4.8
diethylphthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	75	28
2,4-dimethylphenol	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***14***
dimethylphthalate	3,400	100	0.5 - 10	90 - 99	34 - 340	75	28
di-n-butyl phthalate	***< 1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***200***	***28***
2,4-dinitrophenol	< 6,100	100	0.5 - 10	90 - 99	61.00 - 610	200	160
di-n-octyl phthalate	< 1,200	100	0.5 - 10	90 - 99	12.0 - 120	65	28
ethylbenzene	***1,200***	***100***	***0.5 - 10***	***90 - 99***	***12.0 - 120***	***165***	***10***
2-hexanone	< 1,500	100	0.5 - 10	90 - 99	15.00 - 150	5	33
phenol	***< 960***	***100***	***0.5 - 10***	***90 - 99***	***9.6 - 96***	***200***	***6.2***

Notes: Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Bioremediation field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used.

(2) If compound analytical result is less than threshold value, then concentration range is shown.

(3) Other technologies may be used if treatability studies or other information indicates that they can achieve the necessary concentration of percent-reduction range.

(4) TCLP also may be used when evaluating material with relatively low levels of organics that have been treated through an immobilization process.

(5) Shown as the concentration range if the analytical result is less than the threshold value, and as the percent reduction of the feed data if the analytical result is greater than the threshold value

(6) Maximum treatment objectives calculated in accordance with Section 5.6 and Appendix F.

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Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Average Treatment Level	Average (2,3) Percent Reduction
NON-POLAR AROMATICS				
Total:	**21,000**	**90 - 100**	**54**	**99.7%**
benzene	*21,000*	*90 - 99.9*	*54*	*99.7%*
HALOGENATED NON-POLAR AROMATICS				
Total:	**4,860**	**90 - 99.9**	**1570**	**67.7%**
1,4-dichlorobenzene	< 960	90 - 99.9	170	82.3%
hexachlorobenzene	< 1,200	90 - 99.9	100	91.7%
1,2,4-trichlorobenzene	2,700	90 - 99.9	1300	51.9%
HALOGENATED PHENOLS				
Total:	**18,200**	**90 - 99**	**1315**	**92.8%**
4-chloroaniline	< 1,200	90 - 99	115	90.4%
2-chlorophenol	< 1,200	90 - 99	200	83.3%
4-chloro-3-methylphenol	< 1,200	90 - 99	200	83.3%
2,4-dichlorophenol	< 1,200	90 - 99	200	83.3%
pentachlorophenol	< 6,100	90 - 99	200	96.7%
2,4,5-trichlorophenol	< 6,100	90 - 99	200	96.7%
2,4,6-trichlorophenol	< 1,200	90 - 99	200	83.3%
HALOGENATED ALIPHATICS				
Total:	**21,840**	**95 - 99.9**	**394**	**98.2%**
bromodichloromethane	< 790	95 - 99.9	5	99.4%
bromoform	< 790	95 - 99.9	3	99.6%
bromomethane	< 1,500	95 - 99.9	5	99.7%
carbon tetrachloride	< 790	95 - 99.9	5	99.4%
chloroethane	< 1,500	95 - 99.9	5	99.7%
chloroform	800	95 - 99.9	15	98.1%
chloromethane	< 1,500	95 - 99.9	5	99.7%
dibromochloromethane	< 790	95 - 99.9	1	99.9%
1,1-dichloroethane	< 790	95 - 99.9	5	99.4%
1,2-dichloroethane	< 790	95 - 99.9	5	99.4%
1,1-dichloroethylene	< 790	95 - 99.9	5	99.4%
1,2-dichloropropane	< 790	95 - 99.9	5	99.4%
cis-1,3-dichloropropene	< 790	95 - 99.9	5	99.4%
trans-1,3-dichloropropene	< 790	95 - 99.9	3	99.6%
hexachlorobutadiene	< 1,200	95 - 99.9	100	91.7%
hexachloroethane	< 1,200	95 - 99.9	165	86.3%
methylene chloride	< 790	95 - 99.9	5	99.4%
1,1,2,2-tetrachloroethane	< 790	95 - 99.9	2	99.7%
tetrachloroethylene	< 790	95 - 99.9	25	96.8%
1,1,1-trichloroethane	< 790	95 - 99.9	5	99.4%
1,1,2-trichloroethane	< 790	95 - 99.9	5	99.4%
trichloroethylene	< 790	95 - 99.9	5	99.4%
vinyl chloride	< 1,500	95 - 99.9	10	99.3%

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Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Average Treatment Level	Average (2,3) Percent Reduction
HALOGENATED CYCLICS				
Total:	**9,200**	**90 - 99.9**	**905**	**90.2%**
1,2-dichlorobenzene	*1,500*	*90 - 99.9*	*250*	*83.3%*
chlorobenzene	4,100	90 - 99.9	200	95.1%
2-chloronaphthalene	< 1,200	90 - 99.9	200	83.3%
1,3-dichlorobenzene	< 1,200	90 - 99.9	70	94.2%
hexachlorocyclopentadiene	< 1,200	90 - 99.9	185	84.6%
NITRATED AROMATICS				
Total:	**41,300**	**99.9 - 99.99**	**4630**	**88.8%**
nitrobenzene	*8,500*	*99.9 - 99.99*	*3360*	*60.5%*
4,6-dinitro-o-cresol	< 6,100	99.9 - 99.99	200	96.7%
2,4-dinitrotoluene	< 1,200	99.9 - 99.99	200	83.3%
2,6-dinitrotoluene	< 1,200	99.9 - 99.99	125	89.6%
2-nitroaniline	< 6,100	99.9 - 99.99	125	98.0%
3-nitroaniline	< 6,100	99.9 - 99.99	135	97.8%
4-nitroaniline	< 4,800	99.9 - 99.99	85	98.2%
2-nitrophenol	< 1,200	99.9 - 99.99	200	83.3%
4-nitrophenol	< 6,100	99.9 - 99.99	200	96.7%
POLYNUCLEAR AROMATICS				
Total:	**266,270**	**95 - 99**	**17,315**	**93.5%**
naphthalene	*240,000*	*95 - 99*	*12,000*	*95.0%*
2-methylnaphthalene	*9,200*	*95 - 99*	*1760*	*80.9%*
acenaphthene	1,200	95 - 99	380	68.3%
anthracene	560	95 - 99	210	62.5%
benzo(a)anthracene	490	95 - 99	1000	N/A
benzo(a)pyrene	< 1,200	95 - 99	75	93.8%
benzo(b)fluoranthene	< 1,200	95 - 99	65	94.6%
benzo(g,h,i)perylene	< 1,200	95 - 99	60	95.0%
benzo(k)fluoranthene	< 1,200	95 - 99	125	89.6%
chrysene	< 1,200	95 - 99	75	93.8%
dibenzo(a,h)anthracene	< 1,200	95 - 99	85	92.9%
fluoranthene	< 960	95 - 99	200	79.2%
fluorene	3,200	95 - 99	650	79.7%
indeno(1,2,3-cd)pyrene	< 1,200	95 - 99	40	96.7%
phenathrene	1,300	95 - 99	390	70.0%
pyrene	< 960	95 - 99	200	79.2%

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Alternative Treatability Variance Levels for Structural/Functional Groups
Bioremediation -- Material Category B

Structural/ Functional Groups	Feed Treatability Data (ppm) (1)	6A Variance Percent Reduction Range	Average Treatment Level	Average (2,3) Percent Reduction
OTHER POLAR ORGANICS				
Total:	**57,350**	**90 - 99**	**14040**	**75.5%**
toluene	*3,100*	*90 - 99*	*145*	*95.3%*
xylenes (total)	*5,500*	*90 - 99*	*180*	*96.7%*
N-nitrosodiphenylamine	*21,000*	*90 - 99*	*12,000*	*42.9%*
acetone	< 1,500	90 - 99	5	99.7%
bis(2-chloroethoxy) methane	< 1,200	90 - 99	125	89.6%
bis(2-chloroethyl)ether	< 1,200	90 - 99	85	92.9%
bis(2-ethylhexyl)phthalate	< 1,200	90 - 99	200	83.3%
4-bromophenyl phenyl ether	< 1,200	90 - 99	75	93.8%
2-butanone	< 1,500	90 - 99	5	99.7%
butyl benzyl phthalate	< 1,200	90 - 99	30	97.5%
carbon disulfide	< 790	90 - 99	5	99.4%
diethylphthalate	< 1,200	90 - 99	75	93.8%
2,4-dimethylphenol	< 1,200	90 - 99	200	83.3%
dimethylphthalate	3,400	90 - 99	75	97.8%
di-n-butyl phthalate	< 1,200	90 - 99	200	83.3%
2,4-dinitrophenol	< 6,100	90 - 99	200	96.7%
di-n-octyl phthalate	< 1,200	90 - 99	65	94.6%
ethylbenzene	1,200	90 - 99	165	86.3%
2-hexanone	< 1,500	90 - 99	5	99.7%
phenol	< 960	90 - 99	200	79.2%

Table after Superfund LDR Guide 6A (2nd edition) Obtaining Soil and Debris Treatability Variance for Remedial Actions.

Notes:

(1) Feed data obtained from highest concentration of the Group III Impoundments excavated from 1995 and 1996 Bioremediation field pilot study. The greater of the detected value or detection limit (for non- detect compounds) was used.

(2) Based on 6 month average concentration.

(3) The treatement levles for the regulated compounds were only developed for use in the Alternative Treatability Evaluation. Only the eight compoun of concern (italized) are proposed for compliance monitoring.

N/A Not Applicable

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Mass Evaluation

1. **Overall mass evaluation.** The Group III impoundment waste materials subject to biotreatment include Impoundments 4, 5, 14, 20 and 26, and comprise a total mass of 230,467,800 lbs. Of this mass, 45,189,391 lbs (19.6%) consist of regulated compounds[1] based on sampling and analytical data. The composition of the remaining material is water, debris and non-regulated organic and inorganic compounds. The recommended treatment technology, biotreatment, will reduce the mass of regulated compounds to 3,245,266 lbs, or 1.4% of the original total mass. This corresponds to an overall reduction efficiency of 93%. The following table summarizes this evaluation:

9/97#15

Impoundment	Total Mass (lbs)	Mass of Regulated Compounds (lbs)	Total Mass of Regulated Compounds after Biotreatment (lbs)
4	1,963,800	60,586	4,351
5	163,650,000	44,193,028	3,173,712
14	8,728,000	645,217	46,336
20	16,528,000	263,689	18,937
26	39,600,000	26,871	1,930
Total	230,467,800	45,189,391	3,245,266
Percent		19.6%	1.4%

2. **Evaluation of Treatment Objectives.** The following table presents an evaluation, on an individual basis, for the eight compounds of concern for which treatment objectives were previously established. These compounds were identified for compliance monitoring in the April 1996 CMS/FS as they comprise greater than 96% of the total mass of regulated compounds within the Group III impoundments. The remaining regulated compounds each comprise less than 0.5% of the total mass. This evaluation considers mass and volume reduction of the contaminants based on the total mass of the waste material being considered for biotreatment (Impoundments 4, 5, 14, 20 and 26). A sample calculation regarding the mass and volume evaluation for benzene is provided attached.

9/97#15

[1] "Regulated compounds" refers to the organic compounds listed in USEPA's Target Compound List. "Non-regulated compounds" refers to the remaining mass of the material not attributable to water and debris, based on mass calculations. A specific listing of non-regualted compounds does not exist.

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Mass Evaluation

Compound of Concern	Total Mass Before Biotreatment (lbs)	Percent of Waste Material	Total Mass After Biotreatment (lbs)	Percent of Waste Material	Average(1) Treatment Objective (mg/kg)
Benzene	257,901	0.11%	663	<0.01%	54
Toluene	505,878	0.22%	23,662	0.01%	145
Xylene (Total)	460,571	0.20%	15,073	<0.01%	180
Naphthalene	39,516,516	17.15%	1,975,826	0.94%	12,000
Nitrobenzene	336,361	0.14%	132,961	0.09%	3,360
1,2 Dichlorobenzene	253,235	0.11%	42,206	0.02%	250
N-Nitrosodiphenylamine	691,676	0.30%	395,243	0.20%	12,000
2-Methylnapthalene	1,526,957	0.66%	292,113	0.14%	1,760
Totals	43,549,095	18.9%	2,877,747	1.3%	

(1) Based on 6 month average concentration.

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Sample Calculation for Determining Compound Mass

Step 1: Record the compound concentration of the untreated impoundment material from each impoundment subject to biotreatment. Analytical data from the 1995 pilot programs was used.

Step 2: Calculate the impoundment volumes based on previous Impoundment Characterization Program evaluations

Step 3: Record the impoundment material density based on previous Impoundment Characterization Program evaluations.

Step 4: Calculate the total mass of waste material by multiplying the impoundment volumes by the impoundment densities and summing.

Step 5: Calculate the compound mass in each impoundment by multiplying the concentration by the volume and density, making unit conversions as necessary.

Step 6: Sum the compound masses for all of the impoundments subject to biotreatment.

Step 7: Calculate the compound weight percent in the total material by dividing the compound mass by the total mass.

Impoundment	Benzene (mg/Kg)	Impoundment Volume (cy)	Impoundment Density (lb/cy)	Total Mass (lb)	Benzene Mass (lbs)
4	21,000	900	2,182	1,963,800	41,240
5	780	75,000	2,182	163,650,000	127,647
14	350	4,000	2,182	8,728,000	3,055
20	5,200	7,800	2,119	16,528,200	85,947
26	<1	17,600	2,250	39,600,000	32
Total		105,300	2,189 (Wtd Avg)	230,470,000	257,901
				Benzene weight % in total material:	0.11%

American Home Products Corporation
Bound Brook Remedial Program
Revised Group III CMS/FS

Sample Calculation for Determining Mass of Regulated Compounds

Step 1: Obtain mass of impoundment by multiplying volume of impoundment by density, based on values provided in Appendix C.

Step 2: Obtain mass of regulated compounds for each impoundment from pilot study data provided in Appendix C.

Step 3: Obtain the overall mass of regulated compounds after biotreatment by applying the percent reductions calculated in Appendix G for each regulated compound. This is calculated by taking the weighted concentration of each regulated compound and the regulated density for the impoundments containing that compound. Thus, an overall removal efficiency can be obtained on a compound specific basis. An example calculation for benzene is as follows:

Wtd Conc (ppm)	Total Volume (yd^3)	Wtd Density (lb/yd^3)	Compound Mass (lb)	% Red.	Mass Left (lb)
1,134	105,300	2,189	257,901	99.7	663

9477#15

The overall regulated compound removal efficiency for the materials subject to biotreatment is 93%, based on this method. See attached table.

Step 4: Calculate the mass of regulated compounds after biotreatment by assigning the average 93% removal factor to each impoundment subject to biotreatment.

9/97 #15 (New table)

AMERICAN HOME PRODUCTS CORPORATION
BOUND BROOK, NEW JERSEY
Group III Impoundments (4, 5, 14, 20, 26)
Mass Reduction through Biotreatment

Compound of Concern (COC)	Wtd Conc (ppm) (1)	Total Volume (yd3) (2)	Wtd Density (lb/yd3)	Cmpd Mass (lb)	% Red (3)	Mass Remaining	% of Cmpd Remaining
Naphthalene	171,987	105,300	2,189	39,516,516	95.0%	1,975,826	4.372%
2-Methylnaphthalene	7,177	97,500	2,194	1,526,957	80.9%	292,113	0.646%
N-Nitrosodiphenylamine	3,036	104,400	2,189	691,676	42.9%	395,243	0.875%
Toluene	2,202	105,300	2,189	505,878	95.3%	23,662	0.052%
Xylenes (Total)	2,016	105,300	2,189	460,571	96.7%	15,073	0.033%
Nitrobenzene	1,596	96,600	2,194	336,361	60.5%	132,961	0.294%
Benzene	1,134	105,300	2,189	257,901	99.7%	663	0.001%
1,2-Dichlorobenzene	1,102	105,300	2,189	253,235	83.3%	42,206	0.093%
Dibenzofuran	1,353	79,900	2,182	235,959	93.5%	15,337	0.034%
Acenaphthene	1,123	93,500	2,195	229,207	68.3%	72,582	0.161%
Phenanthrene	1,015	97,500	2,194	215,902	70.0%	64,771	0.143%
Fluorene	858	79,900	2,182	149,652	79.7%	30,398	0.067%
Chloroform	800	75,000	2,182	130,920	98.1%	2,455	0.005%
Carbazole	616	79,000	2,182	106,154	93.5%	6,900	0.015%
Chlorobenzene	460	104,400	2,189	102,707	95.1%	5,010	0.011%
Anthracene	531	79,900	2,182	92,610	62.5%	34,729	0.077%
Benzo(a)anthracene	376	97,500	2,194	80,677	N/A	80,677	0.179%
Phenol	287	83,700	2,176	52,479	79.2%	10,933	0.024%
Ethylbenzene	209	105,300	2,189	47,423	86.3%	6,521	0.014%
Fluoranthene	209	93,500	2,195	42,638	79.2%	8,883	0.020%
1,4-Dichlorobenzene	153	101,300	2,189	33,749	82.3%	5,976	0.013%
Dimethylphthalate	651	21,600	2,237	30,675	97.8%	677	0.001%
Pyrene	146	92,600	2,195	29,560	79.2%	6,158	0.014%
1,2,4-Trichlorobenzene	571	22,500	2,235	28,027	51.9%	13,494	0.030%
4-Nitroaniline	140	75,000	2,182	22,911	98.2%	406	0.001%
2-Chloronaphthalene	116	21,600	2,237	5,482	83.3%	914	0.002%
4-Methylphenol	220	4,000	2,182	1,920	75.5%	470	0.001%
2,4-Dimethylphenol	110	4,000	2,182	960	83.3%	160	0.000%
4-Chloroaniline	23	7,800	2,119	380	90.4%	36	0.000%
Bis(2-ethylhexyl)phthalate	3	17,600	2,250	131	83.3%	22	0.000%
1,3-Dichlorobenzene	42	900	2,182	82	94.2%	5	0.000%
3-Nitroaniline	4	7,800	2,119	63	97.8%	1	0.000%
Acenaphthylene	13	900	2,182	26	93.5%	2	0.000%
Chrysene	1	900	2,182	2	93.8%	0	0.000%
Di-n-butylphthalate	1	900	2,182	1	83.3%	0	0.000%
Total Mass of All Material			230,470,000				
Total Mass of COCs			45,189,391			3,245,266	7.181%
				Overall COC Mass Reduction			**92.819%**

AMERICAN HOME PRODUCTS CORPORATION
BOUND BROOK, NEW JERSEY
Group III Impoundments (4, 5, 14, 20, 26)
Mass Reduction through Biotreatment

Notes:

1. Weighted Concentration for Each COC derived from Group III CMS/FS Appendices C & D as follows (using benzene as example):

Impoundment	Benzene Conc. (ppm) from 1995 pilot study	Imp. Volume (yd3)	Density (lb/yd3)	Imp. Mat'l Mass (lb)	Benzene Mass (lb)
4	21000	900	2182	1963800	41240
5	780	75000	2182	163650000	127647
14	350	4000	2182	8728000	3055
20	5200	7800	2119	16528200	85947
26	0.32	17600	2250	39600000	13
		105300		230470000	257901

Average density (lb/yd3) 230470000 / 105300 = 2189

Wtd. avg. benzene conc. (ppm) $\frac{(21000*900 + 780*75000 + 350*4000 + 5200*7800 + 0.32*17600)*2189}{230470000} =$ 1134

2. Total volume based on sum of impoundment volumes where COC was detected (see Appendix C from Group III CMS/FS)

3. Percent reduction based on Group III CMS/FS Appendix G - Alternative Variance Treatability Levels table.

To. Tom Donohue
FAX: 973-683-4066

Total Pgs: 2

State of New Jersey
Department of Environmental Protection

Christine Todd Whitman
Governor

Robert C. Shinn, Jr.
Commissioner

NOV 03 1997

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
NO.

Ms. Patricia Wells McDonald, Manager
Department of Environment & Safety
American Home Products Corporation
One Campus Drive
Parsippany, NJ 07054

Dear Ms. McDonald:

Re: American Cyanamid /American Home Products Site
Bridgewater Township, Somerset County

The New Jersey Department of Environmental Protection (NJDEP) and the United States Environmental Protection Agency (USEPA) have reviewed the revised pages of the Group III Impoundments (1, 2, 3, 4, 5, 14, 20 and 26) Corrective Measure Study/Feasibility Study (CMS/FS) report dated 24 OCT 1997 (received 27 OCT 1997), prepared by O'Brien & Gere (OBG). The revised pages of the CMS/FS report are approved provided the following revisions are incorporated in the final report:

1. Page 5-2, Paragraph 2: Revise as follows: Treatment objectives for metal constituents will be non-leachable as measured by TCLP analysis. Compliance with this objective will be established during the remedial design phase and will consist of the use of pre and post-treatment analytical data. Post-treatment will be conducted to achieve strength criteria, and if necessary, to meet TCLP levels prior to placement in Impoundment 8.

2. Include 2 APR 1997 Plan and Sections of the Impoundment 8 Facility.

3. Provide an updated schedule

Please submit the final CMS/FS to NJDEP and USEPA on or before 6 November 1997.

If you have any questions, please contact me at (609) 633-0718.

Sincerely,

Haiyesh Shah

Haiyesh Shah, Case Manager
Bureau of Federal Case Management

C: Mr. Jim Hacklar, USEPA-SUPERFUND

Exhibit C

Generalized site stratigraphy

Source: BB&L. 1995. *Group III Impoundments Corrective Measure Study/Feasibility Study Report*

FIGURE 2.4.1

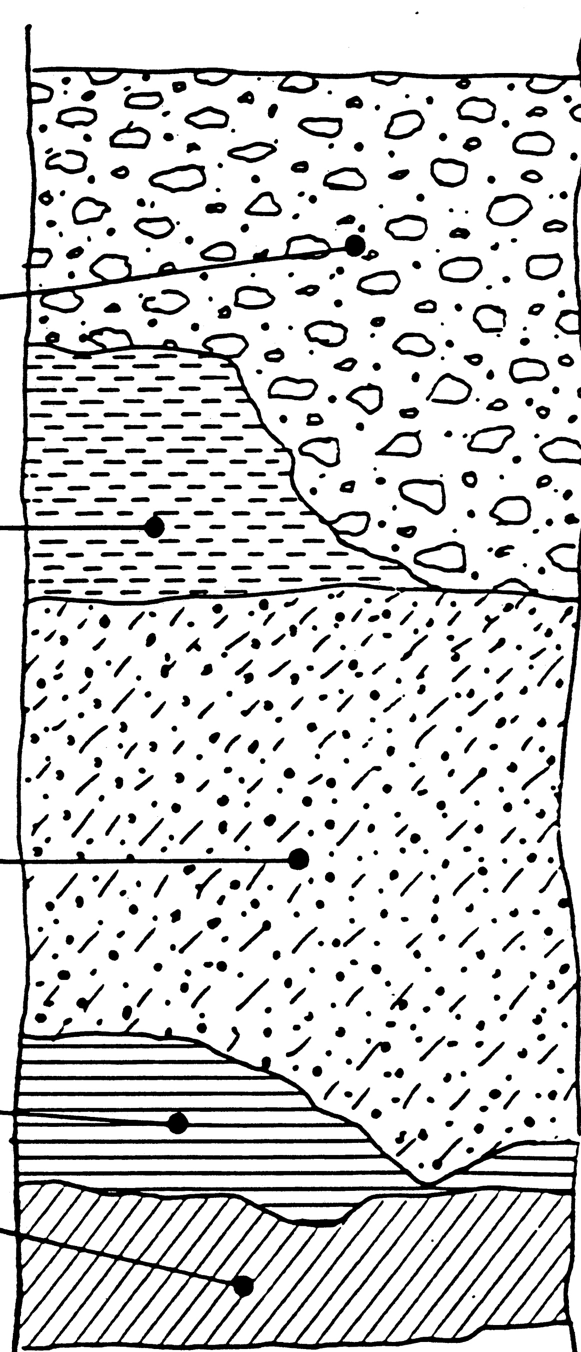
FILL and DISTURBED SOIL: red-brown SAND, SILT and GRAVEL unit ranging from 1 to 18 feet in thickness. Consists of reworked soils, demolition debris and, in areas, waste material. A perched aquifer exists within this unit when the underlying SILT and CLAY layer is present.

SILT and CLAY: An alluvial deposit of grey-brown and brown SILT and CLAY. Present across most of the site and typically ranges from 1 to 4 feet in thickness. In certain areas of the site (main plant) has been excavated.

SAND and GRAVEL: an alluvial deposit of red-brown fine to coarse SAND and fine to very coarse GRAVEL with varying amounts of SILT. This unit is present across most of the site and typically ranges from 3 to 15 feet in thickness. The major overburden aquifer of the site is within this unit. Occasionally, a silt and clay layer is present at its base.

WEATHERED SHALE: A residual unit of decomposed bedrock, red-brown SILT and CLAY with a relic shale texture and shale fragments. It is present only locally and typically ranges form 0.5 to 1.5 feet in thickness when encountered. Acts as a local aquitard.

BEDROCK: Passaic Formation: red-brown sandstone, siltstone, and claystone shale.



AMERICAN CYANAMID
BOUND BROOK, NEW JERSEY

GENERALIZED STRATIGRAPHY

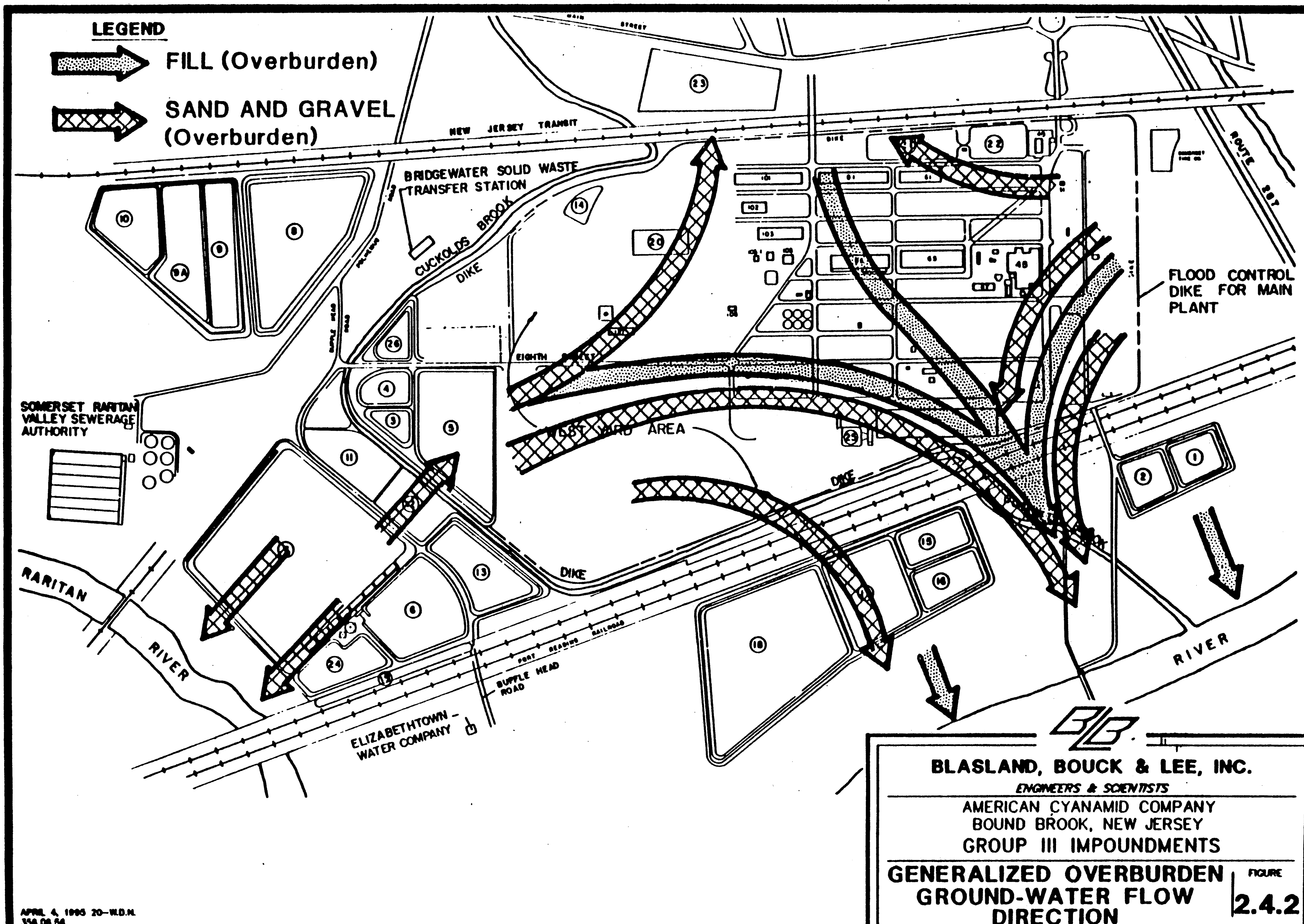
OCT 1990
356.08.10

BLASLAND, BOUCK & LEE
ENGINEERS & GEOSCIENTISTS

Exhibit D

Generalized overburden ground water flow direction

Source: BB&L. 1995. *Group III Impoundments Corrective Measure Study/Feasibility Study Report*



BLASLAND, BOUCK & LEE, INC.

ENGINEERS & SCIENTISTS

AMERICAN CYANAMID COMPANY
BOUND BROOK, NEW JERSEY
GROUP III IMPOUNDMENTS

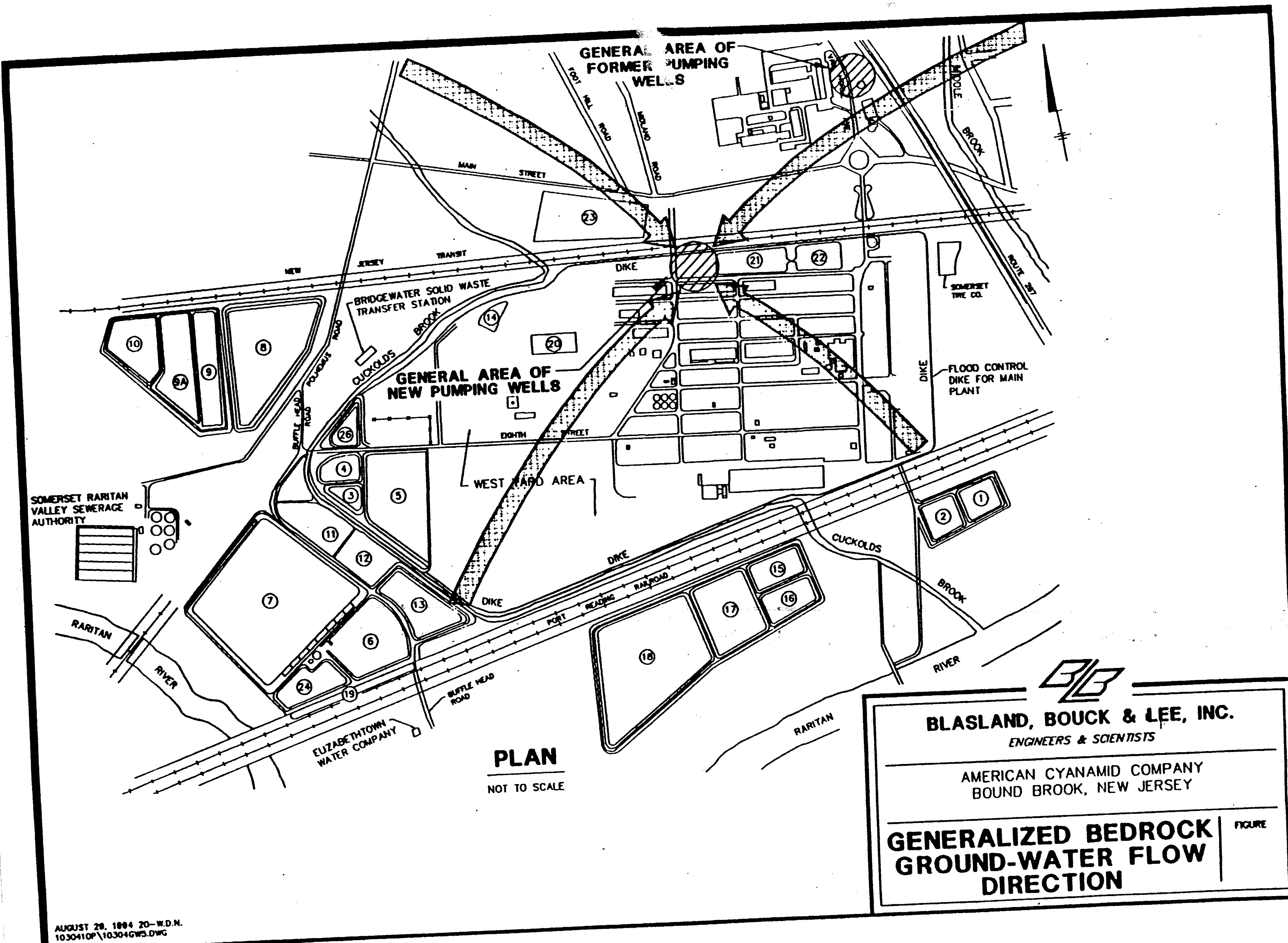
GENERALIZED OVERBURDEN GROUND-WATER FLOW DIRECTION

FIGURE **2.4.2**

Exhibit E

Generalized bedrock ground water flow direction

Source: BB&L. 1995. *Group III Impoundments Corrective Measure Study/Feasibility Study Report*



BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

AMERICAN CYANAMID COMPANY
BOUND BROOK, NEW JERSEY

GENERALIZED BEDROCK GROUND-WATER FLOW DIRECTION

FIGURE

Exhibit H
Attachment 2
Toxicity and Transport Values Used in the Risk Ranking Factor Calculations

Chem Group	Constituent	CASRN	EPA Group	SF_{oral} $(mg/kg/d)^{-1}$			RfD_{oral} (mg/kg/d)			K_{oc} (L/kg)	
				Value	Notes	Ref	Value	Notes	Ref	Value	Ref
SVOC	Naphthalene	91-20-3	D				4.00E-02		43	2.00E+03	40
SVOC	Nitrobenzene	98-95-3					5.00E-04	6	1	6.40E+01	40
SVOC	Phenanthrene	85-01-8	D				4.00E-02	9		1.40E+04	3
SVOC	Phenol	108-95-2	D				6.00E-01		1	2.90E+01	40
SVOC	Pyrene	129-00-0	D				3.00E-02		1	1.10E+05	40

Exhibit H
Attachment 2
Toxicity Value Notes

Note ID	Comment
5	Based on analogy to Benzo(a)pyrene [CASRN 50-32-8] using USEPA relative potency scheme described in reference 10.
6	Under review, according to IRIS.
9	ENVIRON used Naphthalene [CASRN 91-20-3] value from NCEA (reference 43) as a surrogate.
10	ENVIRON used 1,2-Dichlorobenzene [CASRN 95-50-1] values from IRIS {chronic RfDo} (reference 1) and HEAST {chronic RfDi} (reference 2) as surrogates.
14	Data inadequate for quantitative risk assessment, according to IRIS.
18	Not verifiable, according to IRIS.
21	NCEA's Risk Assessment Issue Paper for: 2-Methylnapthalene [CASRN 91-57-6] states that use of Naphthalene as a surrogate for 2-Methylnaphthalene was considered, but the uncertainties in such an approach appear to be too great to warrant its use.
22	NCEA's Risk Assessment Issue Paper for: 3-Nitroaniline [CASRN 99-09-2] and 4-Nitroaniline [CASRN 100-01-6] (reference 44) provides a range of 2.0e-2 to 3.8e-2 (mg/kg-day)-1 as the oral slope factor derived for both 3-Nitroaniline and 4-Nitroaniline.
26	USEPA obtained value by route-to-route extrapolation.

Exhibit H
Attachment 2
Toxicity Value References

Ref ID	Reference
1	USEPA. Integrated Risk Information System (IRIS). On-line database.
2	USEPA. 1995. Health Effects Assessment Summary Tables (HEAST). EPA 540/R-95/036. May and FY-1995 Supplement to HEAST. EPA/540/R-95/142. November.
4	National Cancer Institute (NCI). 1978. Bioassay of dibenzo-p-dioxin for possible carcinogenicity [CASRN 262-12-4]. US Department of Health, Education and Welfare. NTIS PB-288-475.
10	USEPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/2-93/089. July.
34	USEPA. NCEA. 1994. Risk Assessment Issue paper for: Derivation of a Provisional RfD for Chloromethane [CASRN 74-87-3]. March 21.
35	USEPA. NCEA. 1994. Risk Assessment Issue paper for: Quantitative Cancer Risk Assessment for Chloromethane [CASRN 74-87-3]. June 17.
43	USEPA. NCEA. 1995. Risk Assessment Issue paper for: Provisional Oral RfD for Napthalene [CASRN 91-20-3]. Paper received on February 3, 1995.
44	USEPA. NCEA. 1993. Risk Assessment Issue paper for: Derivation of a Provisional Oral RfD, Slope Factor, and Unit Risk for 3-Nitroaniline (CASRN 99-09-2) and 4-Nitroaniline (CASRN 100-01-6). August 20.

Exhibit H
Attachment 2
Transport Value References

Ref ID	Reference
2	USEPA. 1986. Superfund Public Health Evaluation Manual (SPHEM). Office of Emergency and Remedial Response. Office of Solid Waste and Emergency Response. OSWER Directive 9285.4-1. October.
3	USEPA. 1982. Mabey, W., J. Smith, R. Podoll, H. Johnson, T. Mill, T. Chou, J. Gates. I. Partridge, and D. Vandenberg. Aquatic Fate Process Data for Organic Priority Pollutants. Final. Office of Water Reg. & Standards. EPA-440/4-81-014. December.
6	Montgomery, J.H. and L.M. Welkom. 1990. Groundwater Chemicals Desk Reference. Lewis Publishers: Chelsea, MI.
34	USEPA. 1994. Technical Background for Soil Screening Guidance. Office of Emergency and Remedial Response. EPA/540/R-94/106. Review Draft. November.
40	Research Triangle Institute, Center for Environmental Analysis. 1995. Supplemental Technical Support Document for Hazardous Waste Identification Rule: Risk Assessment for Human and Ecological Receptors--Volume 1, TABLE A-1. November 1995.